

CHANGES IN P-WAVE AMPLITUDE AND AXIS AFTER TREATMENT OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE EXACERBATION

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ABSTRACT

Objective: To compare the change in P-wave amplitude and axis before and after 24 hours of the treatment of chronic obstructive pulmonary disease exacerbation.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of medicine, PNS Shifa Karachi from Dec-2010 to June-2011 (six months).

Material and Methods: A total of 93 subjects were included in the study. Their pre-treatment and post treatment ECGs were evaluated by measuring P-wave amplitudes in leads II and aVF and P-wave axes were calculated. The differences in terms of changes in P-wave amplitude and axis were compared.

Results: Mean age of patients was 53.09 ± 7.20 years. Before treatment P-wave amplitude in lead II was 2.36 ± 0.34 mm and after treatment it was 1.73 ± 0.29 mm ($p < 0.001$). P-wave amplitude in lead aVF before treatment was 2.446 ± 0.334 mm while after treatment it was 1.556 ± 0.329 mm ($p < 0.001$). P-wave axis before treatment was $72.67^\circ \pm 4.67^\circ$ and after 24 hours of treatment it was $63.75^\circ \pm 3.95^\circ$ ($p < 0.001$).

Conclusion: Significant changes in terms of reduction of P-wave amplitude and left ward rotation of P-wave axis occur after effective treatment of acute exacerbation of COPD. These findings provide valuable objective evidence in evaluating patient's response to treatment and recommended to be used in clinical practice.

Keywords: COPD, P-wave amplitude, P-wave axis.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease state characterised by chronic airflow limitation which is progressive, not fully reversible and associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily caused by cigarette smoking¹. Apart from affecting the lungs, COPD produces significant systemic consequences^{2,3}. COPD is a global health problem, requiring high healthcare costs and imposes a significant burden in terms of disability and impaired quality of life⁴. COPD affects approximately 5-15% of adult population and according to the World Health Organization, it is currently the sixth leading cause of death in the world^{5,6}. An exacerbation of COPD is the commonest cause (56%) of acute respiratory

failure in Pakistani population^{7,8}. In many respects the lungs and heart comprise a functional unit with interrelations such that disease of one may often affect the other. The electrocardiogram bears a unique relationship to this situation, not only because it reflects certain aspects of cardiac function but also because much of the cardiac potential must traverse lung tissue to reach the recording electrodes. Several studies have reported changes in the activity of heart including P-wave amplitude and axis, rightward displacement of QRS axis, reduction of amplitude of QRS complex in limb and precordial leads, sinus tachycardia, right bundle branch block (RBBB) etc., among COPD patients⁹⁻¹¹. A recent study has demonstrated that P-wave changes (amplitude and axis) associated with COPD are dynamic which means that during an acute exacerbation of the disease there is an increase in amplitude especially in lead II and aVF with a rightward shift of the axis reflecting increased right atrial strain. These changes quickly revert

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back after successful treatment signifying reduced stress to the right heart¹².

The aim of our study was to compare the changes in P-wave amplitude and axis before and after 24 hours of the treatment of chronic obstructive pulmonary disease exacerbation and assess the usefulness of these changes in clinical practice.

PATIENTS AND METHODS

This cross-sectional study was carried out in the department of Medicine, PNS Shifa Karachi

exacerbation requiring prolonged ICU admission and mechanical ventilation were also excluded from the study as to avoid confounding factors affecting ECG in such patients.

COPD exacerbation was defined as an event in the natural course of the disease characterized by worsening dyspnoea, cough and increase in sputum volume and/or purulence that warrant a change in medication. While P-wave amplitude was the vertical height of P- wave on ECG and measured in lead II and aVF in mm and P-wave

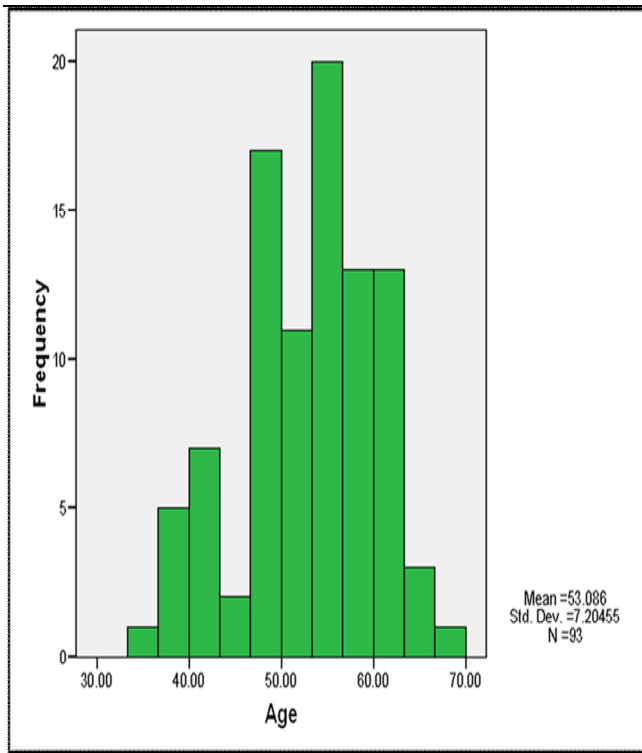


Figure-1: Age distribution of patients (n=93).

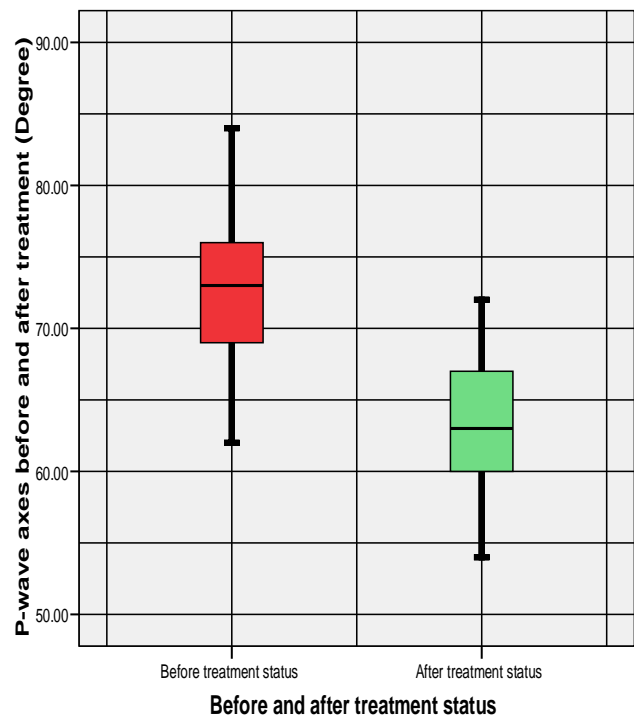


Figure-3: Differences in P-wave axis before and after treatment.

from December 2010 to June 2011. A total of 93 patients more than 35 years of age who were previously diagnosed as having COPD and presented to emergency department with exacerbation of the disease process were included in the study. Subjects with age less than 35 years, having ischemic/valvular heart disease, pneumonia, and bronchial asthma or right heart failure due to causes other than COPD were excluded from the study. Patients with severe

axis was the orientation of P wave in frontal plane and normally ranges from +40° to +60°, and recorded in degrees in lead I and aVF.

Patients fulfilling the aforesaid criteria were enrolled in the study and informed consent was obtained. Vital signs were recorded and pulse oximeter was attached to note SO₂ on air. ECG technician did the ECG of all these patients and both authors 1 and 2 recorded the findings in the emergency department immediately before the

start of treatment. Treatment was started in the emergency department as per existing guidelines of Pakistan Chest Society and updated NICE guidelines consisting low flow oxygen to keep SO_2 between 88-92%, nebulized bronchodilators of SABA and SAMA. Patients were then shifted to medical wards or HDU for further management and further ECG was done on the same patients in

P-wave amplitude was measured in millimeters in lead II and aVF. P-wave axis was measured in degrees in leads I and aVF. Collected data were recorded on a pre designed performa. After recovery patients were discharged as per hospital procedures with a comprehensive follow up treatment plan and follow up instructions. To calculate P-wave axis lead 1 was taken along the

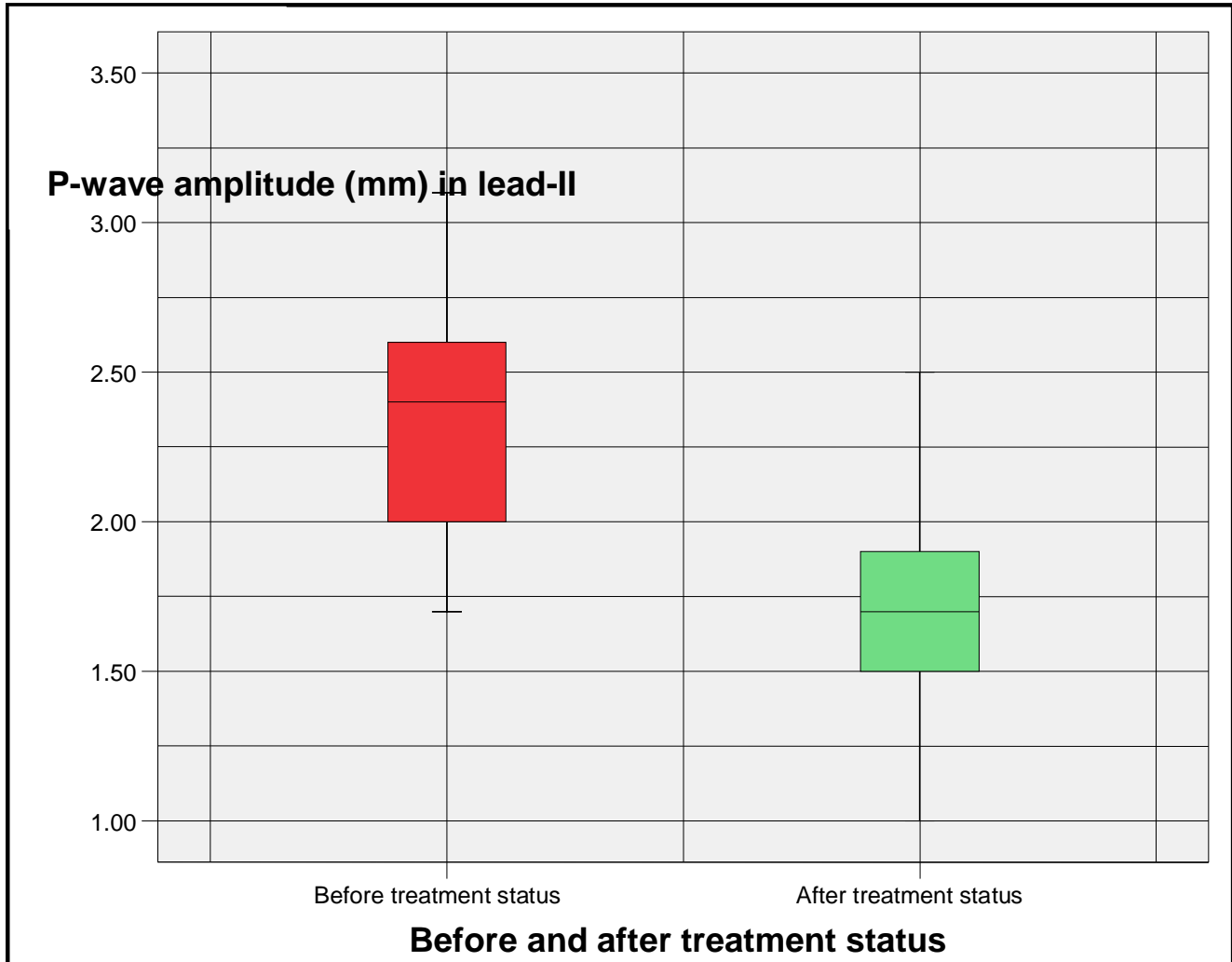


Figure-2(a): Differences between amplitude of P-wave before and after treatment in lead-II.

the wards, 24 hours after the start of treatment using the same ECG machine. Non Invasive Ventilation (NIV) was used in patients with persistent hypercapnic ventilatory failure but patients requiring prolonged invasive mechanical ventilation were excluded.

horizontal axis and lead aVF was plotted along the vertical axis and perpendiculars were drawn at these points to get a point where these two perpendiculars met and a line was drawn from zero to the point where these two perpendiculars intersected. The measurements were taken using geometrical protractor. All data were entered into

SPSS version 15. For the comparison of the amplitudes of P-waves and the axis before and after treatment paired sample t-test was applied. *p* value < 0.05 was considered as significant

RESULTS

In our study 80% patients were males and 20% females. Fig-1 shows age distribution of patients. P-wave amplitudes were significantly reduced after treatment as lead II was 2.36 ± 0.34 before treatment and 1.73 ± 0.29 after treatment. ($p < 0.001$) while in lead aVF it was 2.446 ± 0.334 before treatment and 1.556 ± 0.329 post 24 hours of effective treatment ($p < 0.001$) (Fig-2). While P-wave axis was measured in degrees as 72.67 ± 4.67 before treatment and 63.75 ± 3.95 after successful treatment ($p < 0.001$) Fig-3.

DISCUSSION

This study is the pioneer local clinical

treatment and there is leftward rotation of the P-wave axis. The variability in values of reduction in P-wave amplitude and changes in axis was observed to be depending upon patients prior condition, presence of cor pulmonale, severity of exacerbation and disease duration since all patients received similar treatment as per guidelines. Patients with persistent symptoms and those requiring NIV showed comparatively little but still statistically significant changes in their P-waves. These changes in P-wave occur secondary to reduced right atrial strain and signify effectiveness of treatment. In this regard our findings are comparable to the yield of Asad et al¹².

In our study there were more males than female but there was no statistical significant difference between both the genders regarding amplitude and axis of P-wave. The male

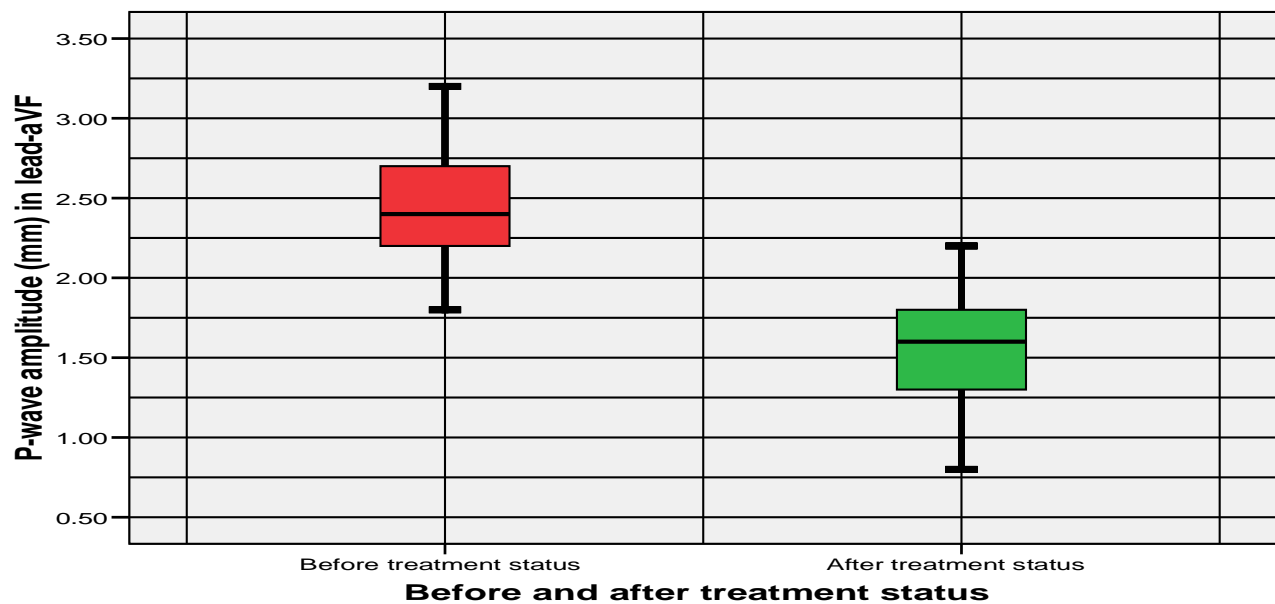


Figure-2(b): Differences between amplitude of P-wave before and after treatment in lead-aVF.

analysis in terms of utilizing ECG data to evaluate patient’s response to treatment of COPD exacerbations. This response was evaluated by incorporating very simple measures from ECG provided data including P-wave amplitude in mm and P-wave axis. The data from our study shows that there was significant though variable reduction in P-wave amplitude after effective

predisposition may have resulted due to their increased outdoor activities, smoking and thus exposure to myriad of environmental pathogens causing some form of pulmonary damage.

Mean age among our study population was between 50-55 years for both male and female gender groups. Some studies have shown higher age during their studies¹³⁻¹⁵ In fact these studies

were mostly from developed countries, and care provision and average age is better than a developing country like ours. Moreover, it also highlights the possibility of different set of allergens and other etiological agents causing an early onset of the disease process in our population. Smoking history was elicited in 75.2% of the population under study.

Few limitations to our study must be acknowledged: Firstly, the inherent weaknesses associated with non-probability consecutive sampling are well recognized. However, keeping in view the nature of clinical atmosphere and the non-timely and odd time presentations of subjects with exacerbations of COPD merits the data yield from such patients is very significant. Secondly, it must also be borne in mind that electrocardiographic changes are not the only findings in a case presenting with COPD exacerbations. COPD is primarily a clinical disorder and clinical relief in terms of settlement of respiratory rate and shortness of breath and reduction in sputum production and purulence help to evaluate the clinical response. Our observed findings should always be interpreted in terms of whole patient scenario.

Our study has important clinical implications. The use of our recommendations to monitor the treatment response by the use of simple ECG related evaluation of P-wave amplitude and axis can help physicians to objectively measure the treatment in clinical practice. Moreover, the study also provides many openings for further research for a multi-central randomized control trial to augment or refute our observations, comparing these ECG changes with echocardiographic findings.

CONCLUSION

Significant P-wave changes in terms of reduction of P-wave amplitude in lead II and aVF and leftward rotation of P-wave axis occur after effective treatment of acute exacerbation of COPD.

These changes are dynamic and signify reduced right atrial strain. In addition to assessing symptomatic improvement in patient's condition, these findings can provide valuable objective evidence in evaluating patient's response to treatment. We recommend that ECGs should be done on all patients in emergency department and then in the wards and these changes should be specifically looked for.

Conflict of Interest

This study has no conflict of interest to declare by any author.

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