Original Article

Prevalence of P wave dispersion and interatrial block in patients with systolic heart failure and their relationship with functional status, hospitalization and one year mortality

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ABSTRACT

Background and objectives: P-wave dispersion (PWD) and Interatrial block (IAB) are common in heart failure (HF), and could be associated with adverse cardiac events. We aimed to assess the prevalence of PWD and IAB and their relationship with functional status, hospitalization and mortality rate in patients with systolic HF.
Methods: We enrolled 110 HF patients in sinus rhythm & LVEF <50%. Patients had undergone clinical evaluation, 6 min walking test (6MWT), 12-lead electrocardiography (ECG), 24-h Holter ECG & echocardiogram. Hospitalization and mortality rate were followed-up for one year. PWD was defined as the difference between maximum & minimum P-wave duration >40 ms. IAB was defined as maximum P duration >110 ms. Measurements were done by 2 blinded investigators using a caliber, a ruler and a magnifying lens.
Results: Mean age was 58.9 ± 9.7 years and 67.3% were males. Prevalence of PWD and IAB was 68.2% and 57.3%, respectively. Patients with PWD showed these features: 84% in NYHA class III or IV HF, 77.4% had LVEF <35%, 78.7% had paroxysmal Atrial Fibrillation (AF) and 89.4% couldn't complete >200 m (m) in 6MWT. Patients with PWD had more hospitalizations (72% vs 28.6%, P value <0.02) and higher 1-year mortality rate (20% vs 8.6%, P value <0.04) than patients without PWD. Likewise, patients with IAB had nearly similar clinical features, hospitalization and mortality as patients with PWD.
Conclusion: PWD and IAB are prevalent in patients with systolic HF and they are significantly associated with low LVEF, paroxysmal AF, poor functional capacity, hospitalization and mortality rate.

1. Introduction

HF is a growing epidemic worldwide, associated with significant morbidity and mortality burden.[1] Several clinical and bedside parameters were investigated to suspect major cardiac events and mortality in HF, including PR interval and P-wave indices. In a recent published study, we reported that prolonged PR interval is associated with short term mortality in HF patients.[2]

However, there are conflicting data and uncertainty in literature regarding the association of prolonged PR interval with morbidity and mortality.[3–5] A study conducted on 2541 deaths retrospectively reported that the association between PR interval and mortality was dependent on the level of P-wave duration, not the PR segment (P < 0.008).[3] Many other studies concluded that no increased mortality among individuals with prolonged PR interval (>200 ms), whereas it was the contribution of the P-wave duration that was associated with morbidity and mortality.[4,5]

Prolongation of P-wave reflects inhomogeneous atrial depolarization in response to several electrical and structural remodelling.[3–6] P-wave duration and PWD are influenced by the autonomic tone, which induces changes in the velocity of impulse propagation. Sympathetic activity has been well known to be elevated in patients with HF and was associated with PWD in patients with paroxysmal AF.[7–10]

Despite the presence of recent publications addressing the issue of abnormal P-wave indices in the general population and in HF patients, their clinical consequences and correlation with morbidity and mortality haven't received significant scrutiny in literature.

The aim of this study was to assess the prevalence of PWD and IAB in HF patients and its correlation with functional status of patients, hospitalization and mortality rate during one-year follow-up.

2. Methods

2.1. Study design

This was a single center, prospective observational study. It was approved by the faculty of medicine - Suez Canal university (FOMSCU) ethical review board.

2.2. Population and data collection

Initially, 125 consecutive HF patients in sinus rhythm were enrolled from March 2014 to July 2015. We included patients presented to the outpatient clinic of the cardiology department FOMSCU hospital with chronic HF, LVEF <50%, in NYHA FC II, III or ambulatory NYHA FC IV, who were stable and not hospitalized during the past 3 months. Patients were excluded if they were <18 years old, permanent AF, liver failure, cancer, renal failure or unable to provide informed consent. All patients have given written informed consent. Only 110 patients completed their follow-up, 5 patients had incomplete data and 10 patients had withdrawn from the study.

2.3. Study protocol

Patients evaluation included: medical history, physical examination, 6MWT, 12-lead ECG, echocardiography and 24-h Holter ECG. Patients were followed up for hospitalization frequency and mortality at the outpatient clinic and by telephone contact or hospital registry data until 1 year from enrollment.

All patients were medically managed according to our institutional guidelines. Blood samples were collected from patients at the time of admission for complete blood count, kidney and liver functions, and electrolytes. Ischemic etiology of HF was considered in patients with angiographically documented IHD, i.e. at least 75% obstruction of at least one coronary artery or 50% obstruction of the left main artery. Other criteria included history of myocardial infarction (MI) admission, evidence of regional wall motion abnormalities detected by echocardiography and the presence of ECG changes suggestive of MI.

2.4. Leads surface ECG

A 12-lead ECG was obtained from all patients in the supine position. All ECGs were recorded at a paper speed of 25 mm/s with 1 mV/cm standardization. The P-wave duration was measured manually by 2 investigators who were blinded to the patients 'clinical status. Manual measurements with hand-held calipers performed by increasing the ECG rate to 50 mm/s with 20 mm/mV standardization, and use of magnifying lens and 0.5 mm scale precision ruler (BIOTRONIC).[6] Then, all ECG strips were examined with automated calculations using Schiller MT-101.

The onset of the P-wave was defined as the junction between the isoelectric line and the beginning of the P-wave deflection. The offset of the P-wave was defined as the junction between the end of the P-wave and the isoelectric line. The maximum and minimum P-wave durations (Pmax and Pmin, respectively) were measured in all leads of the ECG. The PWD was defined as the difference between the Pmax and Pmin.[4]

2.5. Six minutes-walk test

The objective of this test is to walk as far as possible for 6 min. Distance walked was calculated, and any associated symptoms were reported. All vital signs and clinical evaluation were obtained.

2.6. Ambulatory 24-hours Holter ECG

All patients had undergone 24-h Holter at S.C.U hospital, using Schiller device. This test was done for risk stratification of HF, to assess HR variability and record arrhythmias.[10]

2.7. Statistical analysis

All data were gathered, calculated and statistically analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows software, v.22.0. Quantitative variables were presented as mean ± the standard deviation and qualitative variables as frequencies and percentages. Normally distributed data were analyzed using the Student t-test to compare means. The Chi-square test was used to analyze differences between qualitative variables. Multiple logistic regression analysis and Spearman correlation coefficient were used to estimate the correlations between the different variables and abnormal P-wave indices. P value of less than 0.05 was used as a cut off for statistical significance.

3. Results

3.1. Demographic and clinical data

Males constituted 67.3% of study population. The study participants age mean ± SD was 58.9 ± 9.7 years. The most common co-morbidities were: IHD (53.6%), hypertension (26.3%) and diabetes (24.5%), while 52 patients (47.27%) were smokers. Many of the recruited HF patients had multiple co-morbidities. Most of the recruited patients were in NYHA III, IV (68.2%) Table 1.

3.2. Echocardiographic, 6MWT and 24-hours Holter ECG findings

Echocardiographic screening revealed that the study participants had dilated LV& LA with low LVEF. The mean distance walked in the 6MWT was 162.41 m. The 24-h Holter revealed that the mean SDNN was 64.89 ms. Paroxysmal AF was prevalent in 57.3% of patients, other SVT were prevalent in 12.72% of patients. Non-sustained ventricular tachycardia (NSVT) was prevalent in 17.2%, sustained VT was found in 2 patients (1.81%) who gave a history of syncope Table 2.

3.3. Prevalence of PWD and IAB

The prevalence of PWD is 68.2%, while IAB was prevalent in 57.3%. Fig. 1 explains the different P-wave durations and PWD.

3.4. Hospitalizations and mortality rate during one-year follow-up

The mortality rate was 16.3% during one-year follow-up, Moreover, our patients had frequent hospitalizations during one-year follow-up, 58.2% of patients were hospitalized due to decompensated HF more than once, nearly 1/6th of these hospitalizations were more than 3 times (Table 3).