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Original Article

Clinical Significance of P Wave Dispersion in Prediction of Atrial Fibrillation in Patients with Acute Myocardial Infarction

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Abstract

Background: P wave dispersion (PWD) is defined as the difference between the maximum P wave duration (P_{max}) and the minimum P wave duration (P_{min}) in 12-leads of the surface electrocardiography. The aim of this study was to evaluate the values of PWD during atrial fibrillation (AF) after acute myocardial infarction (AMI).

Methods: We prospectively evaluated atrial rhythms of 350 patients (251 males, 99 females) at their first AMI. The measurements included left ventricular ejection fraction (LVEF) and left atrial dimensions (LAD) by means of echocardiography. On admission an ECG was obtained and repeated daily during hospitalization.

Results: Fifty patients had AF after AMI. P_{max} was significantly higher (140.8±18.9 ms) among patients with AF than patients without AF (106.5±17.3 ms). This was also true about P_{min} (66.4±18.3 ms vs. 57.7±15.7 ms), PWD (74.4±20.6 ms vs. 48.7±18.9 ms) and LVEF (35.2±9.4% vs. 39.3±10.9%). Whereas, there was no significant difference between the two groups in respect to LAD (36.5±7.4 mm vs. 35.1± 5.9 mm)

Conclusion: Based on the univariate analysis results, P_{min}, P_{max}, PWD, LVEF and age were significant predictors of atrial fibrillation in patients with first acute myocardial infarction. However, multivariate analysis failed to disclose such independent predictors for atrial fibrillation in these patients.
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Keywords • P wave dispersion • acute myocardial infarction • atrial fibrillation

Introduction

Arrhythmias and conduction disturbances are important comorbidities occurring during managements of early stages of acute myocardial infarction (AMI).[1] Atrial fibrillation (AF) is a common arrhythmia among patients with AMI with incidences ranging from 5% to 23%, however, it is usually transient and resolved spontaneously.[2-6] AF happens more frequently during the first 24-hrs of AMI, and when it occurs, the atrium loses its pumping capability leading to the deterioration of cardiac hemodynamics.[2]
The incidence of congestive heart failure, in hospital and long term mortalities is higher among patients with AF than those

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patients without AF.[7] The P wave duration (PWD) in 12 leads of surface electrocardiography is considered a marker of intra-atrial conduction disturbances which is believed to be the main electrophysiological cause of AF rhythm.[7] Although, PWD is considered as a useful marker of AF risk in many clinical situations, its importance in AMI is controvertial.[8] Therefore, the aim of the present study was to determine whether early measurement of PWD can predict the emergence of AF rhythm after AMI.

Patients and Methods

We prospectively evaluated 350 consecutive patients (251 men, 99 women) with mean age of 61.80±12.11 yrs admitted to Shahid Madani Hospital of Tabriz University of Medical Sciences, with the first AMI attack.

The diagnosis was validated if at least two of the criteria such as clinical history of cardiac enzyme levels and ECG findings were consistent with AMI. AF rhythm was diagnosed, when P waves were absent, or coarse or fine fibrillatory waves according to the available 12-lead ECG recordings, and R-R intervals were completely irregular. On the other hand, normal sinus rhythm was confirmed when P wave had constant configuration in a given lead and with sinus origin (normal mean axis of P wave), P-R interval was normal (0.12-0.20 s), and its rate was 60 to 100 bpm with constant P-P (or R-R) interval.[9]

All patients on admission had an ECG. During hospitalization they had routine daily ECGs and on their third day a two dimensional Doppler echocardiography was performed by Vingmed 750 machine with a probe of 3.25 to determine left atrial diameter (LAD) and left ventricular ejection fraction (LVEF%). ECG was obtained in supine position with Honeywell device on a rate of 50mm/s. The durations of P wave, maximum and minimum P wave (P_{max} and P_{min}) were determined, manually by the aid of caliper and magnifier, on the first ECG, and PWD was calculated accordingly:

$$\mathbf{PWD\ (ms) = [P_{max}\ (ms) - P_{min}\ (ms)]}$$

Statistical analyses

Data are presented as mean±SD. Mann-Whitney U test was applied for comparison of continuous variables and Chi-square test for categorical items in Univariate analysis and $p<0.05$ was considered as significant. Variables with significant difference by Univariate analysis were analyzed by multivariate logistic regression analysis for determining independent variables.

Results

Fifty patients (14.28%) out of 350 patients had AF rhythm during hospitalization (AF group); and the rest of them (300 patients, 85.71%) didn't have AF rhythm (Non AF group).

Table 1: Clinical characteristics of patients with (AF) or without (Non-AF) atrial fibrillation with first acute myocardial infarction

Characteristics		AF (n=50)	Non-AF (n=300)
Gender	male	38 (76%)	213 (71%)
	female	12 (24%)	87 (29%)
LAD (mm)		36.48±7.38	35.11±5.86
Diabetes Mellitus		10 (20%)	49(16.3%)
Hypertension		26 (52%)	124(41.3%)
Hyperlipidemia		12 (24%)	86(28.7%)
Smoking		22(44%)	133(44.3%)

The clinical characteristics of the patients are shown in Table 1. There were no significant differences between patients of the two groups in regard to gender, LAD and other risk factors. As shown in Table 2, the durations of P_{max} and P_{min}, LVEF, age, and PWD of the two groups in the Univariate analysis were significant, but not in multivariate analysis.

Table 2: Significant parameters in Univariate (U) and multivariate (MU) analyses

	AF (n=50)	Non-AF (n=300)	P (U)	P (MU)
Age(yr)	66.9±11.8	60.9±12.0	0.002	0.125
LVEF(%)	35.2±9.4	39.3±10.9	0.015	0.220
P_{min} (ms)	66.4±18.3	57.7±15.7	0.001	0.473
P_{max} (ms)	140.8±18.9	106.5±17.3	0	0.865
PWD (ms)	74.4±20.6	48.7±18.9	0	0.430

For abbreviations see text. $P<0.05$ is considered as significant

Discussion

Clinical significance of PWP has been investigated in many studies such as left atrial enlargement,[10] angioplasty-induced myocardial infarction,[11] angina pectoralis,[12] paroxysmal AF,[13] etc. and after acute anterior MI.[2] In patients with coronary artery disease, multiple etiologic factors may cause atrial arrhythmias.[14] The differences in the conductive properties of the ischemic and its adjacent non-ischemic myocardium may lead to discontinuation of propagation of sinus impulses. Heterogeneous structural and electrophysiological characteristics of atrial muscles are such that they increase the probability of unidirectional block of premature impulses and thence play an important role in the initiation of reentry mechanisms.[15]

During sinus rhythm, the latter 2/3 of the surface P waves represents left atrial depolarization. Enlargement of left atrium increases the duration terminal posterior and leftward component of the P wave and prolongs P wave.[21] Baykan and colleagues reported an increased P_{max} in patients with acute anterior MI and AF rhythm but not in non-AF patients.[2] Our study indicated that the duration of P_{max} was significantly higher in patients with AF. Similar to our findings widening P waves were also reported in patients with acute MI and AF rhythm,[16] or with paroxysmal idiopathic AF.[17] The duration of P_{min} was significantly higher in our AMI patients with AF than those without AF ($P<0.001$). However, Baykan et al. failed to show such a differences in patients with acute anterior MI with and without AF rhythm.[2] This discrepancy might be due to the fact that our sample size was much bigger (350 patients) than theirs (147 patients).

The variation of P_{min} duration can alter the PWD.[18] PWD was significantly higher in our AMI patients with AF than those without AF. Non-homogenous propagation of sinus impulses in the AMI patients with myocardial ischemia, left atrial preexisting dilation, overload and atrial wall fibrosis, may lead to increasing PWD.[13] Dilaveris also reported an increased PWD during spontaneous anginal episodes,[20] and Myrianthefs et al. confirmed this feature in patients with angioplasty induced myocardial ischemia.[19] The same conclusion was made by Baykan et al.[2]

Henry proved that LAD is a major factor for inducing AF rhythm.[20] He concluded that hemodynamic burden on left atrium may cause primarily enlarge its diameter, hence provoking AF rhythm.[20] But, our study did not reveal any significant association between LAD and emergence of AF. Likewise, Sakata et al. reported that patients with AF rhythm after infarction had larger LAD than those without AF.[21] Baykan et al. on the other hand, did not find any difference between LAD in patients with or without AF.[2] In our study age is a predictor of AF rhythm occurrence in patients with AMI, on the results of univariate analyses.

Conclusions

In our study, univariate analysis revealed, maximum and minimum P wave duration as well as PWD, LVEF and age were predictor of AF rhythm following AMI. However, multivariate analysis did not determine the presence of any independent predictor for development of AF rhytm. This observation warrants undertaking further studies in this field.

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