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Original Article

The relationship between P wave dispersion and left atrial volume index in patients with metabolic syndrome

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Abstract

Aim: The incidence of cardiovascular diseases has increased in patients with metabolic syndrome(MS)and left atrial functions also begin to deteriorate from the early period. This effect could be demonstrated by both ECG and Echocardiography. In this study, we investigated the relationship between left atrium volume index (LAVi), which is a sensitive indicator of left atrial dysfunction, and p-wave dispersion (Pd) in patients with MS.

Material and Methods: Patients with MS were included in the study. Baseline ECG and transthoracic echocardiography (TTE) measurements were performed and the correlation between the Pd and LAVi was investigated.

Results: 180 patients were included in the study. The median age of the study population was45(36-57) and 64% was male. In correlation analysis, there was a good correlation between Pd and LAVi(r:0.73 and p<0.001) and moderate correlation between Pd and systolic pulmonary artery pressure(r: 0.32 and p:0.023).In regression analysis, we found a linear correlation between Pd and LAVi(OR:4.3, 95%CI:3.2-8.1, p:0.011)

Conclusions: Left atrial function was deteriorated in MS. This affects could be detected in surface ECG or TTE. In patients with MS, increase in Pd may be a guide for left atrial dysfunction and echocardiographic examination could be a reasonable approach to these patients.

Keywords: Metabolic syndrome; P wave dispersion; left atrial volume index.

INTRODUCTION

The left atrium (LA) has played important roles for a healthy cardiac pump function. It has reservoir, conduction and contraction function. The deterioration of LA functions is closely related to adverse events. In the Framingham study, LA dilatation is associated with long-term mortality (1,2). Left atrial volume index (LAVi), which is obtained by the ratio of left atrial volume to body surface area, is a newly defined parameter and it has been suggested that it may have better predictive values for LA dysfunction or major adverse cardiac events(MACE)prediction when compared to conventional echocardiographic parameters (2,3). In a study, the increase in LA volume was associated with increased postoperative atrial fibrillation (AF) development (4). Metabolic syndrome (MS) is a clinical condition leading to abdominal obesity and dyslipidemia. In patients with MS have increased risk for both diabetes and cardiovascular diseases. In a study, left ventricular global strain (SVGS) was found to be lower in patients with metabolic syndrome than in the control group (5,6).

P wave dispersion (Pd) is defined as the difference between the longest and shortest P waves recorded from different surface electrocardiogram derivations and has been suggested in several studies that may be useful in demonstrating the development of AF. In addition, Pd is also associated with MACE development (7-9). In a study, it was stated that AF development was more in the group with p-wave dispersion Pd could predict AF development (10).

Although both parameters are closely related to LA functions, there is no study to investigate changes in LAVi and PV in patients with metabolic syndrome. In this study, we investigated the relationship between Pd and LAVi in patients with metabolic syndrome.

MATERIAL and METHODS

Patients with MS who applied for cardiovascular risk assessment were included in the study. In the diagnosis of MS, the current NCEP-ATP III consensus report was used (11). Patients with severe valve dysfunction, patients with coronary artery disease, patients with atrial fibrillation, and patients whose records were not available were excluded from the study. Baseline demographic and clinical features were noted and 12-lead surface ECG was

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recorded for all patients. All the ECG's were recorded at a paper speed of 25 mm/with 1 mV/cm standardization. Maximum and minimum P-wave durations are calculated from the standard ECG during sinus rhythm. Pd is derived by subtracting the minimum P-wave duration from the maximum in any of the 12 ECG leads. P-wave onset is determined as the initial deflection from the isoelectric baseline defined by the T-P segment and the P-wave offset is defined as the junction of the end of the P wave and its return to baseline. Patients were then examined by an experienced cardiologist with TTE and measurements were made in accordance with the current guidelines and measurements were recorded to include at least 3 cardiac pulses to be evaluated. The records were then evaluated by another experienced cardiologist who was unaware of the patient's demographic and clinical data, and measurements were taken. Pd was calculated as described in previous studies, and LAVi was calculated by ratio of left atrial maximal volume to body surface area.

Statistics

Continuous variables were expressed as median and categorical variables as percentage. In the correlation of ECG parameters with echocardiographic parameters, spearman correlation analysis was used. In the correlation analysis, significant parameters were subjected to linear regression analysis and P value was accepted as <0.05. Data were evaluated with SPSS version 22 (IBM, Armonk, NY, USA).

RESULTS

A total of 180 patients were included in the study. The median age of the patients was 45(36-57) and 64% was male . The baseline demographic electrocardiographic and echocardiographic characteristics of the patients are shown in Table-1 and Pd and LAVi values of the study population are shown in Figure-1.

In correlation analysis, there was a poor correlation between Pd and Doppler parameters (Table-2), moderate correlation between sPAP and Pd (r = 0.35, p = 0.032) and good correlation between LAVi and Pd (p <0.05). r = 0.73, p <0.001) (Figure-2). In the linear regression analysis, a significant relationship was found between Pd and LAVi (Table-3).

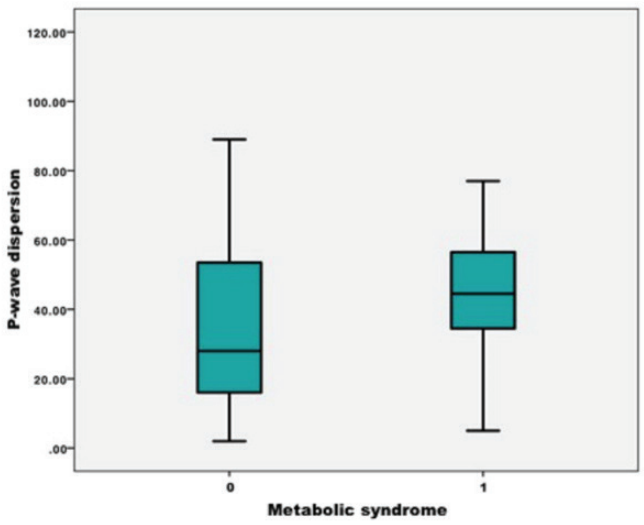

Figure 1. Pd and LAVi values of the study population

Table 1. Baseline demographic electrocardiographic and echocardiographic characteristics of the study population

Variables	N=180
Age(years)	45(36-57)
Sex(male, %)	64
Diabetes Mellitus %	11
Hypertension, %	22
GFR	87.8±12.2
Glucose, mg/dl	103(91-131)
Na	138±4
K	4.1(4.1-4.6)
Ca	9.2±2
Mg	2±0.4
Albumin	4.2±0.5
P max (ms)	121±5
P min (ms)	65±4.6
Pd (ms)	56±4.5
LVDD (mm)	45.3±4
LVSD (mm)	24.7±5.1
LA (mm)	35.1±4.1
LAVi	34.8±4.2
sPAP(mmhg)	23.6±4.2
LV-EF (%)	65.6±6.1
E velocity (m/s)	1.0±0.3
	0.75±0.1
E'(m/s)	0.11±0.03
A'(m/s)	0.14±0.01
IVRT(ms)	84.9±10.3
IVCT(ms)	43.4±9.3

Abbreviations: P max; Maximum P wave duration, P min; Minimum P wave duration, Pd; P wave dispersion, LVDD; left ventricular diastolic diameter, LVSD; left ventricular systolic diameter, LA; left atrium, LAVi; left atrial volume index, sPAP; systolic pulmonary artery pressure, LV-EF; left ventricular ejection fraction, RV-EF; right ventricular ejection fraction, IVRT; isovolumetric relaxation time, IVCT; isovolumetric contraction time

Table 2. Distribution of allergens detected as positive in skin prick test

Variables	P Wave dispersion	
	r value	p value
LVDD (mm)	0.21	0.128
LVSD (mm)	0.18	0.489
LA (mm)	0.33	0.087
LAVi	0.73	<0.001
sPAP(mmhg)	0.32	0.023
LV-EF (%)	0.35	0.325
E velocity (m/s)	0.24	0.109
A velocity(m/s)	0.28	0.092
E'(m/s)	0.19	0.382
A'(m/s)	0.20	0.853
IVRT(ms)	0.21	0.489

Abbreviations: LVDD; left ventricular diastolic diameter, LVSD; left ventricular systolic diameter, LA; left atrium, LAVi; left atrial volume index, sPAP; systolic pulmonary artery pressure, LV-EF; left ventricular ejection fraction, RV-EF; right ventricular ejection fraction, IVRT; isovolumetric relaxation time, IVCT; isovolumetric contraction time

Table 3. Distribution of food allergen positivity in patients with inhaThe relationship between LAVi and Pd in linear regression analysis

Variables	P Wave dispersion				
	r value	Univariate OR, 95% CI	Univariate P value	Multivariate OR, 95% CI	Multivariate P value
LAVi	0.73	6.1(2.2-7.5)	<0.001	4.3(3.2-8.1)	0.011
sPAP	0.32	0.87(0.80-0.95)	0.023	0.8(0.68-1.02)	0.232

Abbreviations: LAVi; left atrial volume index, sPAP; systolic pulmonary artery pressure,

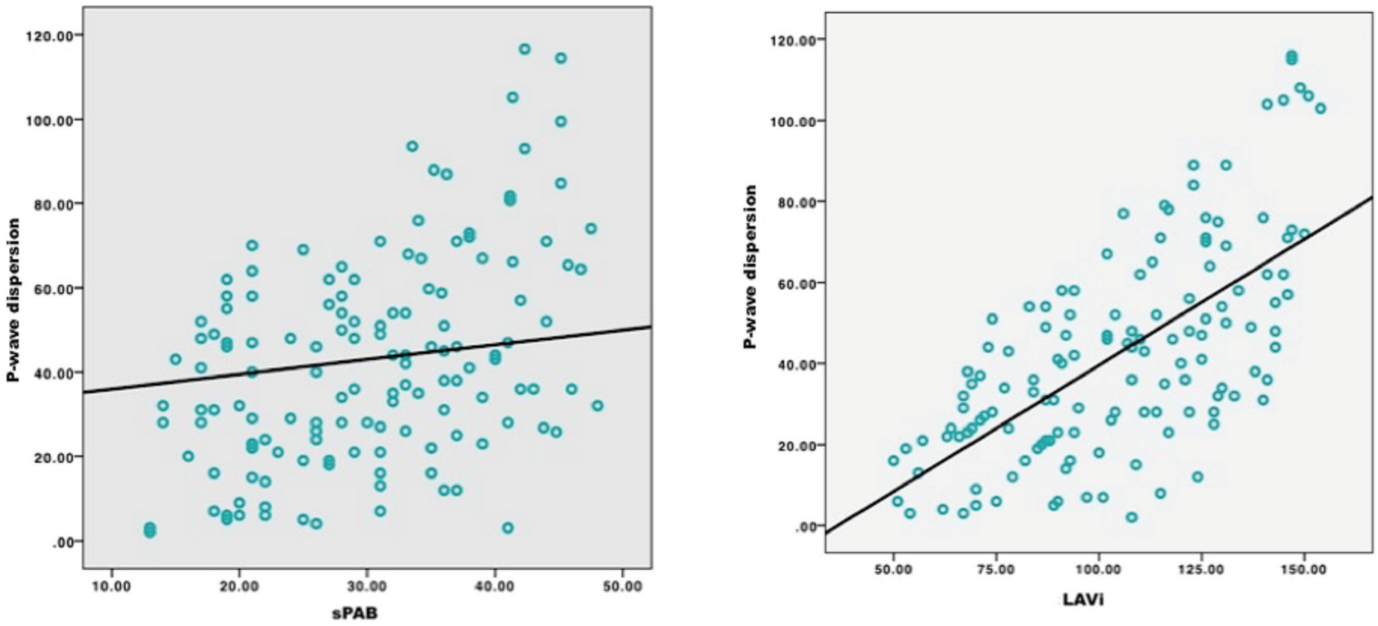

Figure 2. Correlation graph of Pd with LAVi and sPAP

DISCUSSION

In this study, we found a significant relationship between LAVi and Pd in patients with metabolic syndrome and this was the first study in which the relationship was shown.

Pd refers to the difference between the longest and shortest P waves recorded from surface electrocardiogram derivations and studies indicate that Pd could be used to predict arrhythmia and adverse events. In one study, it was reported that AF development was more frequent in patients with increased P wave dispersion. In another study, it has been suggested that changes in Pd may lead to an increase in adverse events at 1-year follow-up (7,9,10).

These changes in the P wave may be associated with increased cytokine and fibrosis and as a result of increased myocardial fibrosis. It has been shown in previous studies that atrial depolarization may be delayed due to increased myocardial fibrosis and this delay plays a key role in the development of AF (5,6,12).

LAVi is a relatively new parameter that can provide more accurate information about the functional status of LA and the relationship between LAVI and cardiovascular disease is well defined. In one study, it was suggested that LAVi is a good predictor in the development of AF in postoperative period and has a better predictive value than LVGLS, whereas in another study it has been associated with increased AF development after mitral valve surgery (3,13-15).

Metabolic syndrome refers to a clinical condition that is associated with insulin resistance, glucose metabolism dysregulation and it has been shown in previous studies that patients with metabolic syndrome may have a tendency both atherosclerosis and diabetes. Left atrial structure and functions are affected from the early period in patients with metabolic syndrome and in patients with MS, changes in the structure and function of LA could be assessed by TTE, which is noninvasive simple and cost-effective than cardiac catheterization (16,17).

In our study, there was a good correlation between Pd and LAVi, and this relationship was still maintained in regression analysis. This relationship is important because both parameters show deterioration in left atrial structure and functions in the metabolic syndrome from the early stage and our findings are consistent with the literature data. In addition, we implied that the increase in Pd in patients with metabolic syndrome may indicate poor left atrial function and these patients may need advanced cardiac evaluation by TTE.

Limitations

Our study has several limitations. First, our sample size is relatively small. Due to local technical unavailability, we could not perform 3D echocardiography or magnetic resonance imaging. Lastly, LA structure and functions could be affected by various diseases such as DM and HT, therefore, these findings need to be confirmed in large-scale studies.

CONCLUSION

The structure and functions of SA can be affected from the early stage in patients with metabolic syndrome and this effect could be assessed by ECG and TTE. Pd could be used to monitor left atrial functions because of the well correlation with LAVi, and it could be used to determine patients who will undergo further examination by echocardiography in appropriate patients.

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