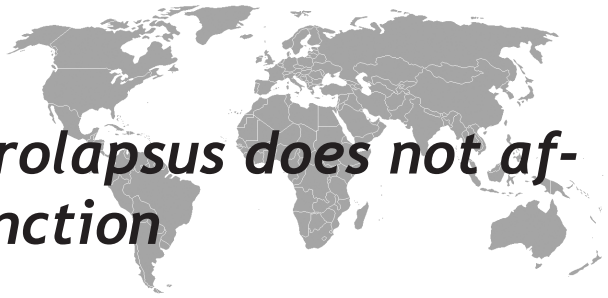

Isolated mitral valve prolapsus does not affect left ventricular function

Insights from tissue-Doppler echocardiography

Kenan Demir[1], Fatih Koc[2], İlknur Can[1], Mehmet Akif Vatankulu[3], Mehmet Yazıcı[1], Mehmet Sıddık Ülgen[4]

[1]*Selcuk University School of Medicine Department of Cardiology, Konya*

[2]*Gaziosmanpasa University School of Medicine Department of Cardiology, Tokat*

[3]*Bezmi Alem University School of Medicine Department of Cardiology, İstanbul*

[4]*Dicle University School of Medicine Department of Cardiology, Diyarbakır/Turkey*

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***Correspondence**: Kenan Demir, MD*
Selcuk University School of Medicine Department of Cardiology, Konya/Turkey
Tel:, E-mail: drkenan76@yahoo.com

ABSTRACT

***Aim**: Idiopathic mitral valve prolapsus (MVP) is characterized by myxomatous degeneration of mitral valve. The most common determinant of cardiovascular mortality in patients with MVP is left ventricular (LV) dysfunction. Therefore we aimed to evaluate LV functions of cases with isolated MVP by tissue Doppler echocardiography (TDE).*

***Method**: Twenty five patients with MVP (mean age, 31±12 years) were enrolled the study as MVP group. Control group was consisted 20 age and sex matched patients (mean age, 34±9 years) were enrolled to this study. LV functions were detected by using conventional echocardiography and TDE. Myocardial peak systolic (Sm), early (Em) and late (Am) diastolic filling velocities, Em/Am, isovolumetric contraction time (ICT), isovolumetric relaxation time (IRT) and ejection time (ET) were obtained in the basal segments of the inferior-septal and lateral wall. Myocardial performance index (MPI) was calculated.*

***Result**: Mild degree mitral regurgitation was present in 10 (40%) of patients with MVP, and moderate degree mitral regurgitation was present in 2 (8%) of patients. No difference was found between the two groups with regard to diastolic parameters. TDE-derivated MPI values were similar in all segments in two groups. There was significant difference between the two groups with regard to LV mean Sm and lateral wall Sm (11.6±2.8 vs. 9.4±1.0, p=0.001; 13.0±3.9 vs. 9.2±2.3, p=0.001 respectively).*

***Conclusion**: Isolated MVP without significant mitral regurgitation does not affect LV diastolic functions and MPI. However, Sm of late ral wall and LV mean was higher in patients with MVP than patients without MVP.*

***Key words**: Mitral valve prolapse, tissue Doppler echocardiography, myocardial performance index*

İzole Mitral Kapak Prolapsusu Sol Ventrikül Fonksiyonunu Etkilemez

Amaç: *İdiopatik Mitral Kapak Prolapsusu (MVP), mitral kapağın miksomatöz dejenerasyonuyla karakterizedir. MVP'li hastalarda kardiyovasküler mortalitenin en önemli belirleyicisi Sol Ventrikül (LV) disfonksiyonudur. Bu yüzden biz izole MVP hastalarında doku doppler ekokardiyografi (TDE) ile LV fonksiyonunu değerlendirmeyi amaçladık.*

Metod: *MVP'li 25 hasta (ortalama yaş, 31±12) çalışmaya MVP grubu olarak dahil edildi. Kontrol grubu ise yaş ve cinsiyet eşleştirilmiş 20 hastadan oluşturuldu (ortalama yaş, 34±9). LV fonksiyonları konvansiyonel ekokardiyografi ve TDE ile incelendi. Miyokardiyal zirve sistolik (Sm), erken (Em) ve geç (Am) diastolik dolum hızları, Em/Am, isovolumetrik kontraksiyon zamanı (ICT), isovolumetrik relaksasyon zamanı (IRT) ve ejeksiyon zamanı (ET) ölçümleri inferior-septal ve lateral duvarın bazal segmentlerinden ölçüldü. Miyokardial performans indeksi (MPI) hesaplandı.*

Bulgular: *MVP'li hastaların 10'unda (%40) hafif derecede mitral yetmezlik, 2'sinde (%8) orta derecede mitral yetmezlik vardı. Diastolik parametreler açısından 2 grup arasında fark bulunamadı. TDE'den hesaplanan MPI değerleri iki grupta tüm segmentlerde benzerdi. Sol ventrikül ortalama Sm ve lateral duvar Sm'de iki grup arasında anlamlı fark vardı (11.6±2.8 vs. 9.4±1.0, p=0.001; 13.0±3.9 vs. 9.2±2.3, p=0.001 sırasıyla).*

Sonuç: *Belirgin mitral yetmezliği olmayan izole MVP sol ventrikül diastolik fonksiyonunu ve MPI'yi etkilemez. Fakat, MVP'li hastaların lateral duvar Sm ve LV ortalama Sm'si MVP'si olmayanlara göre daha yüksekti.*

Anahtar kelimeler: *Mitral kapak prolapsusu, doku doppler ekokardiyografi, miyokardiyal performans indeks*

INTRODUCTION

Idiopathic mitral valve prolapsus (MVP) is characterized by myxomatous degeneration of mitral valve and shows a heterogeneous range of clinical course from asymptomatic to severe morbidity and mortality (1). Although MVP prevalence is high in earlier echocardiographic studies, the current echocardiogarphic diagnostic criteria are taken into consideration the prevalence of it in the population is 1-2.5% (1,2). Baseline clinical and echocardiographic parameter, are strong predictors of outcome and are essential for clinical management. The most common determinant of cardiovascular mortality in patients with MVP is left ventricular (LV) ejection fraction (EF) lower than 50% (3). Although LV dysfunction is detected in most of the transthoracic echocardiographic, radionuclide ventriculographic and dobutamine stress echocardiographic studies done to evaluate LV functions in cases with MVP, inconsistent results are present (4-7).

Tissue Doppler echocardiography (TDE) is a non invasive and very sensitive method that serves the possibility of evaluating regional myocardial systolic and diastolic functions. Very few studies are present in the literature in which LV systolic and diastolic functions of the cases with MVP were determined by TDE. Myocardial performance index (MPI) is a new parameter correlated with the invasive values of LV function that helps us evaluate both the systolic and diastolic function without being affected by cardiac rate, blood pressure and ventricular geometry. It can be calculated by Pulsed Wave (PW) TDE method from the mitral annulus (8). There is limited data about findings of TDE in patients with MVP. Therefore we aimed to evaluate LV functions of cases with isolated MVP by TDE.

MATERIALS AND METHODS

Study Population

Twenty five consecutive patients (11 male; mean age, 31±12 years) who admitted to cardiology clinic with symptoms of fatigue, palpitation, dyspnea on exertion and atypical chest pain, and who had MVP in echocardiographic examination were enrolled to this study. Echocardioraphically, mitral valve prolapse is defined as systolic deplacement (≥2.0 mm) of one or both mitral leaflets into the left atrium in the long axis annular plane (2). Age and sex matched 20 individuals (8 male; mean age, 34±9 years) were taken as control group. Subjects with blood pressure >140/90 mmHg, any personal history of systemic disease which may affect the cardiovascular system, unexplained chest pain, diabetes mellitus and renal failure, hypo/hyperthyroidism, abnormal ECG changes, rheumatic valvular heart disease, congenital heart disease, cases receiving medicines affecting myocardial functions such as beta blockers and Ca^{+2} channel blockers were excluded from the study. All patients and controls underwent conventional and pulse wave TDE evaluation.

Echocardiography

Transthoracic echocardiographic assessment was performed in the left lateral decubitus position, using ATL-5000 standard ultrasound machine (Advance Technology La¬bo¬ratories, Bothell, Washington) with a 2.5-3.5 MHz transducer. Images were obtained in the standard tomographic views of the LV (parasternal long and short axis and apical four-chamber, two-chamber, and long-axis views). Mitral inflow velocities were recorded by using conventional pulsed-wave Doppler echocardiography, positioning a sample volume at the level of the mitral leaflet tips in the apical four-chamber view. The peak early diastolic velocity (E), peak late diastolic velocity (A), E/A ratio, isovolumetric relaxation time (IRT), and E-wave deceleration time (EDT) were measured on line. Recordings were performed at the end of normal expiration in order to eliminate the effects of respiration on the parameters studied. Left ventricular diameters and wall thicknesses were measured from the two-dimensional targeted M-mode echocardiographic tracings in the parasternal long axis, according to the criteria of the American Society of Echocardiography (9). The LV end-diastolic and end-systolic volumes at rest were computed from two- and four-chamber views, using a modified Simpson's method, and the LV EF was calculated.

The echocardiograph machine was used to acquire colour tissue Doppler data using a high frequency acquisition. Color-coded TDE cine loops obtained with >100 frames/s from the apical 4-chamber view were used for TDE measurements. The filter settings were kept low (50 Hz), and gains were adjusted at the minimal optimal level to minimize noise and eliminate the signals produced by the transmitral flow. A 3.5 mm sample volume was used. In the apical 4-chamber view, myocardial peak systolic (Sm, cm/s), early (Em, cm/s) and late (Am, cm/s) diastolic filling velocities, Em/Am ratio, isovolumetric contraction time (ICT), isovolumetric relaxation time (IRT) and ejection time (ET) were obtained by placing a tissue Doppler sample volume in the basal segments of the inferior-septal and lateral wall. All examinations were performed using harmonic imaging. MPI was calculated using (ICT+IRT)/ET Formula (10). Mean myocardial velocities of LV, mean MPI and mean Em/Am ratios were calculated by dividing the sum of Sm, Em, Am velocity and Em/Am ratio measured from two different parts of LV by two.

Three consecutive cycles were averaged for every parameter. The operator was blinded to the clinical details and results of the other investigations in each subject and control. The intraobserver variability of echocardiographic measurements was less than 6%.

Table 1*. Clinical Characteristics and Echocardiographic Measurements in MVP and Controls*

	MVP(n:25)	*Control(n:20)*	*p value*
Age (y)	*31±12*	*34±9*	*ns*
Male, n(%)	*11(44)*	*8 (40)*	*ns*
BMI (kg/m2)	*28±5*	*26±5*	*ns*
SBP (mmHg)	*112±12*	*105±17*	*ns*
DBP (mmHg)	*71±9*	*68±12*	*ns*
Heart rate (beats/min)	*79±11*	*76±10*	*ns*
LVESD (cm)	*2.69±0.4*	*2.71±0.3*	*ns*
LVEDD (cm)	*4.38±0.4*	*4.41±0.5*	*ns*
IVS (cm)	*0.80±0.9*	*0.72±0.8*	*ns*
PW (cm)	*0.81±0.9*	*0.72±0.9*	*ns*
EF (%)	*64±7*	*65±6*	*ns*
FS (%)	*38±4*	*39±5*	*ns*
LA (cm)	*3.4±0.6*	*3.6±0.4*	*ns*
E-wave (m/s)	*0.79±0.14*	*0.73±0.11*	*ns*
A wave (m/s)	*0.59±0.14*	*0.61±0.14*	*ns*
E/A	*1.42±0.4*	*1.25±0.4*	*ns*
EDT (ms)	*170±36*	*168±35*	*ns*
IRT (ms)	*68±12*	*79±19*	*ns*
Mean sloping (mm)	*3.4±0.8*	-	
Leaflet thickness (mm)	*5.5±0.5*	-	

BMI, Body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; LVESD, left ventricle end systolic diameter; LVEDD, left ventricle end diastolic diameter; IVS, interventricular septum; PW, psterior wall; EF, ejection fraction; FS, fractional shornening; LA, left atrium; EDT, E deceleration time; IRT, izovolumetric relaxation time; NS, not significant.

***Table 2**. Tissue Doppler Echocardiography Parameters in MVP and Controls*

	MVP(n:25)	*Control(n:20)*	*p value*
Lateral Wall			
Sm (cm/s)	*13.0±3.9*	*9.2±2.3*	*0.001*
Em (cm/s)	*17.7±5.1*	*16.3±2.6*	*ns*
Am (cm/s)	*11.1±2.6*	*11.5±1.8*	*ns*
Em/Am			
ICT (ms)	*64±15*	*65±16*	*ns*
IRT (ms)	*63±22*	*64±15*	*ns*
MPI (ms)	*0.45±0.1*	*0.47±0.1*	*ns*
Inferior Septal Wall			
Sm (cm/s)	*10.2±2.3*	*9.6±1.2*	*ns*
Em (cm/s)	*13.2±3.2*	*11.5±2.4*	*ns*
Am (cm/s)	*11.8±4.3*	*11.6±2.2*	*ns*
Em/Am			
ICT (ms)	*65±14*	*68±15*	*ns*
IRT (ms)	*66±13*	*66±18*	*ns*
MPI (ms)	*0.48±0.1*	*0.49±0.1*	*ns*
LV mean			
Sm (cm/s)	*11.6±2.8*	*9.4±1.0*	*0.001*
Em (cm/s)	*15.5±3.8*	*13.9±2.3*	*ns*
Am (cm/s)	*11.5±2.7*	*11.5±1.4*	*ns*
Em/Am	*1.41±0.4*	*1.22±0.2*	*ns*
ICT (ms)	*64±10*	*65±12*	*ns*
IRT (ms)	*63±15*	*64±11*	*ns*
MPI (ms)	*0.47±0.06*	*0.48±0.08*	*ns*

Sm, systolic myocardial velocity; Em, early myocardial velocity; Am, late myocardial velocity; LV, left ventricle; ICT, isovolumetric contraction time; IRT, isovolumetric relaxation time; MPI, myocardial performance index; NS, not significant.

Statistic analysis

All statistics were calculated by the SPSS software 11.0 for Windows (SPSS. Inc). Descriptive data are expressed as a mean value ± SD. Student-t test was used for comparisons between parametric continuous variables and Mann Whitney U test was used for comparisons between non parametric continuous variables. Chi-square test was used for the comparison of the categorical variables. A value of P <.05 was considered significant.

RESULTS

Patients Characteristics and Conventional Echocardiography

Statistically significant differences in demographic and clinical characteristics between the two groups were not observed (Table 1). Baseline physical examination revealed midsystolic click during auscultation in 9 (36%) cases and chest pain was present in 16 (64%) cases and palpitation was present in 18 (72%) patients Echocardiographic evaluation demonstrated mild degree mitral regurgitation was present in 10 (40%) of subjects with MVP, and moderate degree mitral regurgitation was present in 2 (8%) of subject. Severe mitral regurgitation was not found in the MVP group. Mean leaflet thickness and amount of sloping of the mitral valve was 5.5±0.5 mm and 3.4±0.8 mm in the MVP group respectively. No statistically significant difference was found regarding the systolic and diastolic function, as measured by means of the conventional 2D echocardiographic EF, fractional shortening (FS) and Doppler derived E, A, E/A, EDT and IRT between the two groups (Table 1).

Tissue Doppler Echocardiography

No difference was detected between two groups with regard to parameters such as Em, Am, Em/Am and MPI derived from base of inferior-septal and lateral wall. Also while no difference was found in Sm of MVP and control group derived from basal segment of inferior septum (10.2±2.3 vs. 9.6±1.2, P >0.05), Sm values derived from of lateral wall was significantly higher in MVP group than controls (13.0±3.9 vs. 9.2±2.3, P =0.001). When the mean values of LV septal and lateral wall of two groups were compared, no difference was detected in mean Em, Am, Em/Am and mean MPI value of MVP and control groups. But LV mean Sm value was significantly higher in MVP (11.6±2.8 vs. 9.4±1.0, P =0.001) (Table 2).

DISCUSSION

In the present study, LV lateral wall and LV mean Sm appeared significantly higher in MVP patients than in control group. However, LV diastolic parameters and MPI were similar with control group.

Although the reason is not clarified, pathologically myxomatous degeneration of valve leaflets, chordae tendineae, and annulus is seen and eventually it causes mitral regurgitation. Also, even though mitral regurgitation does not develop, at least theoretically, the degeneration of mitral apparatus causes LV dysfunction around the apparatus. In some biopsy studies, LV dysfunction due to myocardial fibrosis and mitochondrial degeneration were detected in some cases with MVP (11). Also it was shown in some studies that even in the absence of coronary artery disease, local ischemia and myocardial dysfunction were present around mitral apparatus because of coronary spasm or microcirculation disorder in some cases with MVP (12,13). But in a recent myocardial perfusion imaging study done with SPECT in MVP cases who had angina like chest pain MVP, no significant perfusion defect related to ischemia was detected (14).

Tissue Doppler echocardiography is a very sensitive method in determination of global and regional systolic and diastolic functions (15). It was shown in previous studies that mitral annular velocities by TDE from the apical 4-chamber view (average from infero-septal and lateral sites) have the potential to estimate rapidly the global LV function (16). TDE derived MPI is an important parameter showing both systolic and diastolic functions and it was found to be related to mortality (17). The evaluation of LV functions in MVP patients is very little in the literature. Dagdeviren et al. observed different Doppler patterns in the LV posterior and lateral walls with pulsed-wave TDE and spice on systolic velocity (65%) (18). In our study, LV lateral wall pulsed-wave TDE and systolic velocity (Sm) were high in MVP patients compared to control group. In evaluation of only base of LV inferior wall by TDE, similar to our study, Zampoulakis et al. (19) found that during resting Sm was higher than controls (11.9±2.7 cm/s vs 9.5±1.1 cm/s, P <0.001). But in their study, diastolic functions (Em/Am) were lower than controls (1.3±0.4 vs 2±0.4, P =0.001). The difference in diastolic functions of both studies may be explained by relatively lower age of subjects in our study (31±12 vs 45±13). Increased myocardial systolic velocity in MVP patients might be due to concominant mitral regurgitation. But in really, the relation between the mitral regurgitation and myocardial systolic velocity have not been demonstrated in both, in effort or resting in the trials (19). Increase in the LV lateral wall Sm in our patients may be related to authonomic status. In previous studies it was shown that in cases with MVP, especially in symptomatic cases, sympathetic activity increases (20). Cathecolaminergic functions were increases whereas vagal response was found as decreased. Zdrojevski et al. (21) reported an increased plasma rennin activity in MVP patients compared to control group. Also Pedersen et al. (22) obtained positive correlation between MVP grade and plasma rennin activity in dogs.

Study limitations; The most important limitation of the study was the small number of cases. Nevertheless, firstly the study included the highest number of patients, evaluated by TDE. Secondly, the main reason of the small volume is that we used strict criteria while selected patients.

In conclusion, isolated MVP without severe mitral regurgitation does not affect LV diastolic functions and LV MPI but may cause limited increase in systolic functions. Furthermore, our study is the first study assessing LV systolic and diastolic functions in MVP patients. So LV MPI was similar in MVP patients compared to control group. However the result of this study should be supported by studies with large number of cases.

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