Effect of Treatment on Echocardiographic Variables in the Follow-Up of Dilated Cardiomyopathy

DİLATE KARDİYOMİYOPATİLİ HASTALARIN TAKİBİNDE TEDAVİNİN EKOKARDİYOGRAFİ PARAMETRELERİNE ETKİSİ

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Abstract

Objective: Dilated cardiomyopathy (DCM) is a myocardial disease characterized by impaired systolic function and dilation of the left or both ventricles. Despite advances in the medical management of patients with DCM, the mortality rate for this condition remains high. The purpose of the present study was to assess the echocardiographic predictors of improvement in the follow-up of dilated cardiomyopathy.

Material and Methods: Sixty-six consecutive patients with DCM (left ventricular ejection fraction [LVEF] <40% at the initial assessment and left ventricular end diastolic diameter [LVEDD] >55 mm) diagnosed for the first time were included in the study. Demographic, clinical and echocardiographic variables were recorded. ACE inhibitor, diuretic and whenever possible digitalis, spiranolactone and beta-blocker therapy were administered to all of the patients. After 12 months of follow-up, echocardiographic analyses of the patients were reviewed and compared with the initial data.

Results: Four patients died during the follow-up period. The comparison of the final and initial data revealed a significant difference in LV mass (LVM), ejection fraction (EF), deceleration time (DT), ejection time (ET) and myocardial performance index (MPI).

Conclusion: LVM, EF, DT, ET and MPI changes significantly after medical treatment of DCM patients and can predict improvement in these patients.

Key Words: Echocardiography, cardiomyopathy, dilated

Özet

Amaç: Dilate kardiyomiyopati sol ya da her iki ventrikülün sistolik fonksiyonlarında bozulma ve dilatasyonla seyreden bir hastalıktır. Medikal tedavideki ilerlemelere rağmen ölüm oranı yüksektir. Bu çalışmanın amacı, tedavi altındaki hastaların takiplerindeki iyileşmenin ekokardiyografik değişkenlere ne şekilde yansıdığını saptamaktır.

Gereç ve Yöntemler: İlk kez tanı alan DKM'li 66 hasta çalışmaya alınmıştır (ekokardiyografik olarak ejeksiyon fraksiyonları (EF) %40'ın altında ve sol ventrikül diyastol sonu çapları >55 mm). Hastaların klinik, ekokardiyografik ve demografik kayıtları alındıktan sonra, ACE inhibitörü, diüretik ve tolere edildiğinde dijital, spiranolakton ve beta bloker başlanmıştır. Hastalar, 6 aylık aralıklarla toplam 12 ay boyunca takip edilmiştir ve izlem bulguları, ilk bulgularla karşılaştırılmıştır

Bulgular: Ölen 4 hasta çalışma dışı bırakılmış, iyileşen ya da durumu stabil seyreden hastaların sonuçları karşılaştırılmıştır. Ortalama sol ventrikül kütlesi, EF, deselerasyon zamanı, ejeksiyon zamanı ve miyokard performans indeksinde anlamlı farklılık saptanmıştır.

Sonuç: Ortalama sol ventrikül kütlesi, EF, deselerasyon zamanı, ejeksiyon zamanı ve miyokard performans indeksi dilate kardiyomiyopatili hastaların takiplerinde kullanılabilecek, iyileşmeye işaret eden anlamlı parametrelerdir.

Anahtar Kelimeler: Ekokardiyografi, dilate kardiyomiyopati

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Dilated cardiomyopathy (DCM) is a myocardial disease characterized by impaired systolic function and dilation of the left or both ventricles.[1] Despite recent advances in medical and surgical therapies, it remains an important cause of mortality and morbidity and is among the major indications for heart transplantation. Echocardiography is an important tool for diagnosis and follow-up of these patients. This study was conducted prospectively, to determine the effect of treatment on echocardiographic variables in the follow-up of DCM patients.

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Material and Methods

Patients: Sixty-six patients (49 males and 17 females) were enrolled in this study between September 2001 and September 2002 who were admitted to the clinic of İstanbul University Institute of Cardiology. Abant İzzet Baysal University Düzce Medical School Ethics Committee approved the study protocol and each subject signed a written informed consent prior to enrollment.

Sixty-six consecutive patients who were diagnosed as DCM for the first time in their life, using transthoracic echocardiography (left ventricular ejection fraction [LVEF] <40% and left ventricular end diastolic diameter [LVEDD] >55 mm) were included in the study. Patients with primary valvular disease, active myocarditis or a history of myocarditis, clinical or echocardiography features consistent with an obstructive, hypertrophic or restrictive cardiomyopathy, pericardial disease, primary hepatic, renal, neurological, pulmonary or endocrine disease, and arrhythmias that could alter LVEF were excluded. All patients underwent cardiac catheterization. Patients who had normal coronary arteries were classified as ‘idiopathic’ and the remaining group as ‘ischemic’ DCM.

Baseline evaluation and follow-up: Past and current medical history, symptoms and physical examination findings of all patients were recorded at the time of entry. Baseline variables included New York Heart Association functional class, routine blood chemistry, chest X-ray and 12-lead electrocardiogram (ECG) recording. Baseline transthoracic echocardiograms were obtained by using a commercially available sector scanner (Acuson Sequa C 256) with a 3.5-MHz transducer. Two-dimensional echocardiograms and Doppler tracings of mitral inflow were recorded. Left atrial size, LVEDD and left ventricular end-systolic dimensions (LVESD) were measured from M-mode tracings of parasternal long- and short-axis views. LVEF was derived from apical two and four chamber views according to the modified Simpson rule. All measurements were performed in triplicate and averaged. Transmitral flow velocity tracings were obtained by pulsed wave Doppler echocardiography from apical four-chamber views, with the Doppler sample volume positioned at the tips of the mitral leaflets where color flow indicated maximal flow. From mitral inflow patterns, we derived peak early (E) and late (A) diastolic flow velocities, their E/A ratio and deceleration time (DT) of early inflow defined as the slope from peak E extrapolated to the baseline value. LV mass (LVM) was calculated using the Penn convention: $LVM= 1.04\cdot[(EDD + PWTD + VSTD)^3-(EDD)^3]-13.6$ g, where end-diastolic dimension (EDD), posterior wall thickness in diastole (PWTD), and ventricular septal thickness in diastole (VSTD). The mean values were obtained by averaging at least three consecutive beats.

All patients received a diuretic (furosemide) using a flexible regimen, a low dose spironolactone (25 mg), and a high dose angiotensin-converting enzyme inhibitor (lisinopril 10 mg/daily), which was replaced by angiotensin type 1 receptor blockers if lisinopril was not tolerated. Carvedilol and digitalis were administered if tolerated and if not contraindicated. Anticoagulant treatment was recommended in patients with a valvular prosthesis and atrial fibrillation. Patients were scheduled for regular clinical, echocardiographic and hemodynamic follow-up every six months.

Patients were considered to have improved when a shift to or stability at a lower New York Heart Association (NYHA) functional class was achieved or any increase in LVEF was documented during one of the clinical and echocardiographic evaluations performed during follow-up.

Statistical analysis

Continuous variables were expressed as mean value ± 1 SD and categorical data as percentages. Paired t test was used to measure the variations of clinical and echocardiographic variables documented during follow-up in the individual study groups. A p value < 0.05 was considered statistically significant.

Results

Patients were followed-up for 12 months. At the end of one year, 4 patients had died. Of the patients who survived, 51 improved and 11 remained stable.

The clinical and demographic data of the study group is shown in Table 1. The mean age of the patients who survived was 58 ± 11. Forty-five of them were males and 17 were females. Coronary angiography analysis revealed that half of the patients were idiopathic in origin (31 cases).

We compared the following initial and final echocardiographic variables of each patient: LVEDD, LVESD, left atrial diameter (LAD), LVM, LV end-diastolic volume (LVEDV), LV end-systolic volume (LVESV), ejection fraction (EF), right ventricular diameter (RVD), e, a, DT, ejection time (ET), isovolumetric contraction time (IVCT) and relaxation time (IVRT), myocardial performance index (MPI) and pulmonary artery pressures (PAP). The data are shown in Table 2. The mean LVM, EF, DT and ET values significantly increased whereas the mean MPI value significantly decreased after treatment. Ischemic and idiopathic subgroups of DCM patients were analyzed in different sessions. EF and DT showed statistically significant differences between the two groups after treatment (p< 0.001). MPI (p: 0.004) and ET (p< 0.001) variables were also significantly different in the ischemic DCM group (Table 3).

Table 1. Clinical characteristics of the study group.

	N (%)
Smokers	39 (62)
Alcohol consumption	10 (16)
Diabetes mellitus	14 (23)
Hypertension	21 (34)
Digitalis use	48 (77)
ACE inhibitor use	55 (89)
ACE receptor blocker use	3 (5)
Diuretic use	59 (95)
Spironolactone use	50 (80)
ASA use	57 (92)
Warfarin use	28 (45)
Beta blocker use	13 (21)
Amiodarone use	11 (18)
Statin use	11 (18)
Fibrate use	3 (5)

Discussion

Results from the present study documented that the mean LVM, EF, DT and ET values signifi-

Table 2. Comparison of echocardiographic variables documented at the initial and follow-up assessments.

	Initial assessment (N: 62)	At the end of follow-up (N: 62)	T value	Degree of freedom	p value
LVEDD	72 ± 9	73 ± 10	-1.463	61	0.149
LVESD	63 ± 9	63 ± 13	-0.154	61	0.878
LVM	374 ± 112	403 ± 119	-2.189	61	0.03
LAD	45 ± 5	44 ± 8	-0.718	61	0.189
EF	25 ± 5	29 ± 5	-9.463	61	<0.001
FS	13 ± 4	15 ± 3	-1.738	61	0.184
LVEDV	244 ± 84	256 ± 99	-1.181	61	0.242
LVESV	188 ± 80	188 ± 76	-0.046	61	0.963
RVD	27 ± 3	26 ± 3	-0.313	61	0.728
E	0.77 ± 0.24	0.77 ± 0.24	-0.436	61	0.91
A	0.58 ± 0.20	0.63 ± 0.25	-0.0865	45	0.06
DT	106 ± 38	133 ± 50	-10.505	61	<0.001
IVRT	101 ± 18	103 ± 14	-0.9	61	0.372
ICRT	92 ± 32	92 ± 37	-0.046	61	0.964
ET	275 ± 28	291 ± 33	-4.092	61	<0.001
MPI	0.71 ± 0.14	0.68 ± 0.17	3.35	61	0.001
PAP	44 ± 8	45 ± 7	-1.433	61	0.157

LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter, LAD: Left atrial diameter, LVM: Left ventricular mass, LVEDV: Left ventricular end-diastolic volume, LVESV: Left ventricular end-systolic volume, EF: Ejection fraction, RVD: Right ventricular diameter, DT: Deceleration time, FS: Fractional shortening, IVCT: Isovolumetric contraction time, IVRT: Isovolumetric relaxation time, MPI: Myocardial performance index, PAP: Pulmonary artery pressure.

Table 3. Comparison of echocardiographic variables of ischemic and idiopathic DCM patients that were analysed in different sessions.

	Initial assessment of ISCHEMIC DCM patients (N: 31)	At the end of follow-up of ISCHEMIC DCM patients (N: 31)	T value	Degree of freedom	p value
EF	25 ± 5	29 ± 4	-8.774	30	<0.001
DT	109 ± 38	133 ± 50	-8.367	30	<0.001
ET	275 ± 28	291 ± 33	-4.451	30	<0.001
MPI	0.71 ± 0.14	0.68 ± 0.17	3.117	30	0.004
	Initial assessment of IDIOPATHIC DCM patients (N: 31)	**At the end of follow-up of IDIOPATHIC DCM patients (N: 31)**	**T value**	**Degree of freedom**	**p value**
EF	25 ± 5	29 ± 4	-4.02	30	<0.001
DT	107 ± 379	133 ± 51	-6.872	30	<0.001

EF: Ejection fraction, DT: Deceleration time, ET: Ejection time, MPI: Myocardial performance index.

cantly increased whereas the mean MPI value significantly decreased after treatment of DCM patients. Echocardiography is a valuable tool both in the diagnosis and follow-up of DCM. Two-dimensional and Doppler echocardiography facilitates the evaluation of different periods of the cardiac cycle, allowing the acquisition of a combined systolic and diastolic index of LV performance in a simple, reproducible, and reliable manner.[2]

One of the independent predictors of improvement in our study was the LVM. This was not reported in the literature before. A possible explanation for this interesting observation may be the negative remodelling (thinning) phenomenon of the myocardium, which was prevented after the treatment. We thought that the increase in the myocardial mass without any significant change in the left ventricular dimensions (diastolic or systolic) might be due to a gain in the thickness of the LV wall. The prevention of the thinning of the myocardium might have lead to a small but significant change in the LVM.

Among the echocardiographic parameters, we found that a short DT was associated with a poor prognosis in patients with DCM. This finding is in accordance with previous reports.[3-5] A short DT is characterized by a restrictive left ventricular filling pattern and is associated with a poor prognosis.[6] Restrictive left ventricular filling pattern is frequent in DCM, is associated with more severe disease and is a powerful indicator of increased mortality risk and the need for heart transplantation.[3] Patients with restrictive filling patterns are more symptomatic, have more extensive left ventricular dilation and a lower LVEF compared to patients without restrictive filling patterns.[1] A shortened DT (<130 ms) identifies a subgroup of patients with a poor outcome. DT and peak early Doppler velocity were the strongest predictors of survival in a study by Werner et al as compared to the systolic function and clinical status in a Cox proportional-hazards analysis.[7] The increase in DT after treatment shows the improvement in diastolic cardiac function. Several studies reported that the mitral DT was also an independent predictor of subsequent mortality in patients with heart failure.[4,5]

EF quantitatively measures the systolic function of the left ventricle. It is a well-known index of improvement and survival in heart failure patients.[4] Our study which was consistent with previous data revealed that EF could predict improvement in patients with heart failure.

Among the measures of MPI, ET strongly predicted cardiac improvement in the present study. Because myocardial contractility and relaxation are energy-dependent, myocardial dysfunction results in the prolongation of the isovolumic intervals.[8] As the severity of the LV dysfunction increases, the ejection period shortens. Thus, the MPI index (the sum of IVCT and IVRT divided by ET) increases accordingly and vice versa happens in case of improvement. MPI reliably shows the combined LV systolic and diastolic function and it is independent to heart rate and blood pressure.[9,10] MPI was first suggested by Tei et al who reported a negative correlation between this new index and clinical outcome in patients with heart failure.[2] Dujardin et al also found it to be a significant prognostic index in a similar patient population.[11] Although it is a valuable index, our study revealed that at least the change in MPI in case of an improvement in heart failure is most likely due to the improvement and prolongation of ET. In our patient group treatment led to an increase in ET, rather than a change in IVCT and IVRT.

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