

The left ventricular systolic and diastolic functions in asymptomatic diabetic patients*

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Left ventricular systolic (LVEF) and diastolic (peak filling rate "PFR") functions were examined in 23 diabetic patients (pts) (9 females, 14 males, aged 16-68 years) without cardiac findings using equilibrium radionuclide ventriculography at rest and investigated the relationships with microvascular complications, cardiac autonom neuropathy, the duration of disease and the glycemic control. Comparisons were made with 10 age and sex-matched normal subjects. Of 23 pts, 5 pts were taking insulin and 18 pts were taking oral hypoglycemic agents. The mean duration of disease was 5,1±4,2 years. The mean level of HbA_{1c} was 10±2,5%. There was no significant difference between mane LVEF and PFR values of diabetics and normals (54,3±6,8% vs 56,1±5,1%, p>0,05; 2,7±0,8 EDC/sec vs 3,0±0,5 EDC/sec, p>0,05, respectively). But 11 (47,8%) diabetics had abnormalities of left ventricular diastolic filling, although 4 (17,4%) diabetics showed systolic and diastolic dysfunction. In diabetics with cardiac dysfunction, 4(36,4%) pts had cardiac autonom neuropathy, 2(18,2%) pts had microalbuminuria and 5(45,5%) pts had higner HbA_{1c} levels. The duration of disease, microvascular complications, cardiac autonom neuropathy and theglycemic control were not correlate to the abnormalities of the left ventricular function. [Turk J Med Res 1993; 11 (4): 179-182]

Key Words: Diabetes mellitus, Left ventricular function, Radionuclide ventriculography

Hypertension, coronay artery disease and obesity which may cause cardiac dysfunction are frequently associated with diabetes mellitus, but diabetics may have abnormalities in left ventricular function even without these conditions (1). In cilinical studies on diabetics, systolic time intervals, Doppler echocardiography and radionuclide ventriculograhpy have been used to evelaute the left ventricular performance (1-10).

In this study, we examined by radionuclide ventriculography in asymptomatic diabetics whether the impairment of left ventricular systolic and diastolic function was present and their relationship with microvascular complications, cardiac autonom neuropathy, the glycemic control and the duration of disease

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MATERIALS AND METHODS

Tewenty-three diabetic patients (pts) without symptoms of heart disease, hpyertension and conditions known to effect the left ventricular function (9 females, 14 males, aged 16-68 years) were subjected in the study.

All pts Body Mass Index (kg/m²) below 25. The history of chronic alcoholism was absent. None of the pts had any clinical, electrocardiographic, X-ray or echocardiographic evidence of cardiac abnormality. While none of the pts had symptoms suggestive of angina, treadmill exercise testing using Bruce protocol was performed in pts above 40 years of age. All had normal exercise testing results. Diabetes was present from 2 months to 15 years (5,1±4,2 years). Eighteen subjects were on oral hypoglycemic agents and 5 subjects received insulin.

Autonomic neural functions was assessed by the heart rate responses to Valsalva maneuver and to deep breathing and by the blood pressure responses to standing (11). If two of them were abnormal, cardiac autonom neuropathy was present.

Table 1. The clinical features and indexes of cardiac function in diabetic subjects.

Case	Age (yr) Sex	Duration of DM (yr)	Treatment	HbA _{1c} %	R	N	Autonom Neuropathy	EF %	PFR (EDC/sec) ¹
1	41F	1	OHA	8,2				54	3,1
2	57M	8	"	7,9				52	2,7
3	43F	6	"	12,0		+	+	54	5,7
4	68M	2	"	14,0		+	+	53	2,9
5	52M	9	"	9,7		+		48	1,8
6	65M	15	"	8,2	+		+	67	2,9
7	45F	7	"	14,6			+	55	2,6
8	56F	8	"	7,9		+	+	53	2,0
9	62M	15	"	13,6				62	2,9
10	46F	1	"	8,8		+		69	4,3
11	52M	2	"	13,2		+		67	1,6
12	44M	2 months	"	8,5				50	2,8
13	42M	6	"	7,1				55	2,3
14	52M	4	"	8,9			+	54	2,3
15	37M	2	Insulin	12,6			+	45	1,7
16	31F	1	"	8,6				51	3,1
17	30M	2	"	6,9				56	2,5
18	36F	5	OHA	12,6		+		51	2,7
19	27M	1	Insulin	7,6				46	2,1
20	50F	9	OHA	7,5				47	2,5
21	16M	1	insulin	8,0				51	3,0
22	55F	4	OHA	13,3				54	1,5
23	61F	4	"	10,2				70	2,7

(mean ± Sd) 54,3 ± 6,8 2,7±0,8

DM: Diabetes Mellitus, R: Retinopathy, N: Nephropathy, EF: Ejection Fraction, PFR: Peak Filling Rate, OHA: Oral Hypoglycemic Agent, F: Female, M: Male.

Glycosylated haemoglobin (HbA_{1c}) was measured by column chromatography. The upper limit of normal was 8 %.

Radionuclide ventriculography was performed after an intravenous injection of Technetium 99^m-RBC (20 mCi) using a gamma camera (GE.Starcam 3000) in the supine position at rest. The left anterior oblique projection was used. The left ventricular ejection fraction (LVEF) and peak filling rate (PFR) were calculated (12).

Ten subjects between 20 and 65 years of age (4 females, 6 males) who had no history of diabetes in themselves or in their families served as control subjects.

Student's t-test was used to test differences between variables.

RESULTS

In 23 diabetics, the mean (±SD) fasting blood glucose was 168,5±54 mg/100 ml. The duration of disease was 5,1±4,2 years, The mean value of HbA_{1c} was 10,0±2,5 %. Diabetic retinopathy was found in only one patient. Seven diabetics had microalbuminuria and 7 subjects showed autonom neuropathy.

In diabetics, left ventricular EF was found to be 54,3±6,8% (ranges from 45 % to 70 %), but

56,1±5,1% (ranges from 50 % to 65%) in normals (P>0,05).

Left ventricular diastolic function (PPFR) did not show significant differences between diabetics and normals (2,7±0,8 EDC/sec, 3,0±0,5 EDC/sec, p>0,05). Although the mean value of left ventricular systolic and diastolic function parameters did not show statistically significant difference in diabetics than normals, 11(47,8%) diabetics had lower values of PFR, but 4(17,4%) subjects both systolic and diastolic dysfunction. The clinical features and indexes of cardiac function in diabetes and normals were given in Table 1 and 2.

The abnormalities of left ventricular function were not related to microvascular complications, autonom neuropathy, the level of HbA_{1c} and the duration of disease. In 11 pts with left ventricular dysfunction, 2(18,2 %) pts had microalbuminuria, 4(36,4 %) pts had autonom neuropathy, 5(45,5%) pts had high level of HbA_{1c}. The duration of diabetes mellitus was 4,5±2,8 years in subjects with impairment of left ventricular function, but 6,0±5,2 years in subjects with normal cardiac function (Table 3,4).

DISCUSSION

The syndrome of congestive heart failure occurs with increased frequency in patients with diabetes mellitus

Table 2. The values of left ventricular systolic and diastolic parameters in control subjects.

No	EF%	PFR (EDC/sec)
1	60	3,0
2	54	3,0
3	50	2,6
4	52	3,5
5	65	4,3
6	55	2,8
7	60	3,0
8	59	2,6
9	62	2,8
10	50	2,7
mean±Sd	56,1 ±5,1	3,0±0,5

EF. Ejection Fraction, PFR. Peak Filling Rate.

Table 3. Autonom neuropathy and left ventricular functions in diabetes mellitus.

	EF(%)	PFR(EDC/sec)
Diabetics with autonom neuropathy n-7	54,3±7,2	2,9±1,2
Diabetics without autonom neuropathy n-16	55,4±7,5	2,6±1,0
	P>0,05	p>0,05

EF: Ejection Fraction, PFR: Peak Filling Rate.

Table 4. The level of HbA_{1c} and cardiac dysfunction in diabetics.

	Cardiac dysfunction(+)	Cardiac dysfunction(-)
	n-11	n-12
HbA _{1c} (%)	10,0±3,0	10,0±2,4
	P>0,05	

and contributes significantly to their increased cardiovascular mortality (1,13). It is considered that this condition is in dependent of coronary artery disease, hypertension and other factors. Impaired left ventricular function may frequently be detected in asymptomatic diabetics (1,2,7,8). Left ventricular diastolic filling abnormalities might be seen before systolic dysfunction (3-5,9,14). Both of them was considered to be a preclinical manifestation of cardiac malfunction (1-10). Whether to observead functional abnormality may progress to cilinical heart failure may depend on intensification of the underlying pathophysiology in the myocardium or the superimposition of complications such as hypertension, obesity or obstructive disease of the coronary vessels. Microangiopathic lesions in the myocardium, altered composition of myocardial inter-

stitium, changes in myocardial lipid metabolism, cardiac autonom neuropathy, the impairment of myocardial energy metabolism were suggested to be causes of diabetic cardiomyopathy but there were not strictly evidences (1,7,9,10,13-15).

We found that 47,8 % of asymptomatic diabetics had abnormal left ventricular diastolic filling. Four of them showed both systolic and diastolic dysfunction. The results were confirmed by other investigators (3-6,9,10,14).

The abnormalities of left ventricular function were correlated to the peresence and extent of diabetic microvascular complications and the duration of diabetes (3). Additionally, the diabetes as having cardiac autonomic neuropathy had depressed left ventricular diastolic filling compared with subject free or autonomic neuropathy. Alterations in sympathetic nervous system activity were associated with abnormalities of left ventricular diastolic filling in diabetics (9,10). However, in some studies it was found different results (2,8). Some investigators suggested that left ventricular systolic function was normal at rest but not during exercise (7,8). Abnormal cardiac dysfunction was not correlated with fasting blood glucose levels (2). Neither did duration of diabetes appear to be determining factor, although larger numbers and a more precise means of dating the onset of diabetes would be required for a firm conclusion as to the inter-relationship of disease duration (2).Indexes of left ventricular diastolic filling showed abnormalities in 29 % of diabetics and these finding did not show relationship with duration of diabetes and microvascular complications (4).

Our results suggested that cardiac dysfunction in diabetes was not dependent on the duration of disease, the glycemic control, cardiac dysfunction in asymptomatic diabetics would have a significant prognostic value because it might cause to accelerate the effects of other factors that increased cardiovascular morbidity and mortality.

Asemptomatik diabetik hastalarda sol ventrikül sistolik ve diastolik fonksiyonları

Kalp hastalığı olmayan, yaşları 16 ile 68 arasında değişen, 9'u kadın, 14'ü erkek 23 diabetli hastada sol ventrikülün sistolik (EF: Ejeksiyon Fraksiyonu) ve diastolik (PDW: Pik doluş hızı) fonksiyonları istirahatte radyonüklid ventrikülografi ile değerlendirildi ve mikrovasküler komplikasyonlar, kardiyak otonom nöropati, hastalık süresi ve kan glukoz seviyesinin regülasyonu ile ilişkileri araştırıldı. Yaş ve cins olarak uygunluk gösteren 10 sağlıklı kişi kontrol grubunu oluşturdu. Yirmi üç hastadan 57 insülin, 18'i ise oral antidiabetik ilaç kullanıyordu. Ortalama hastalık süresi 5,1±4,2 yıldır. Ortalama HbA_{1c} düzeyi % 10,0±2,5 idi. diabetes mellitus-

lu hastalar kontrol grubu arasında, ortalama sol ventrikül EF ve PDH değerleri anlamlı farklılık göstermedi (%54,3±6,8, %56,1±5,1, $p>0,05$; 2,7±0,8 EDC/sn, 3,0±0,5 EDC/sn, $P>0,05$). Fakat 11 (%47,8) hastada sol ventrikül diastolik doluş anormalliği saptandı ve bunların 4(% 17,4)'ünde sistolik fonksiyon bozukluğu da belirlendi Sol ventrikül fonksiyonlarında azalma olan diabetli hastaların 4(%36,4)'ünde otonom nöropati, 2 (%18,2)'sinde mikroalbuminüri ve 5(% 45,5)'ünde yüksek HbA_{1c} seviyeleri tesbit edildi. Sol ventrikül fonksiyonlarındaki bozukluk ile diabetes mellitusun süresi, mikrovasküler komplikasyonlar, kardiyak otonom nöropati ve kan glukozunun regülasyonu arasında bir ilişki bulunmadı.

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