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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

The effect of left ventricular diastolic function on the secretion of B-type natriuretic peptide at rest and directly after exercise test in asymptomatic patients with diabetes or after myocardial infarction with preserved left ventricular systolic function

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Abstract

Background: Clinical evaluation of patients with diabetes or after myocardial infarction (MI) with preserved left ventricular (LV) systolic function is not very precise in isolating patients at particularly high risk of developing manifest cardiac failure and associated cardiovascular incident. Early diagnosis of LV diastolic dysfunction is essential because implementation of the appropriate treatment can positively affect the course of the disease.

Aim: To assess the impact of LV diastolic function on B-type natriuretic peptide (BNP) concentration at rest and immediately after exercise test, and to search for the relationship between LV diastolic function and BNP secretion, tolerance, and duration of exercise in the studied groups of patients.

Methods: Ninety-nine consecutive patients were qualified for the study: in Group 1 — patients with type 2 diabetes without a history of MI, and in Group 2 — patients after MI with preserved LV systolic function (ejection fraction ≥ 40%), without diabetes. The studied patients had echocardiography with LV systolic and diastolic function evaluation, an electrocardiographic exercise test and blood sampling for BNP determination before and immediately after exercise test.

Results: The study included 99 patients aged 40–75 years (60 patients after MI and 39 patients with diabetes). The study group included 62 patients who were diagnosed with diastolic dysfunction. Diastolic dysfunction occurred in 41 (68.4%) patients in the group after MI, and in 21 (53.8%) patients in the group with diabetes, severe disorders in the form of pseudonormal and restrictive mitral valve inflow occurred in 13 (21.7%) and five (12.8%), respectively. The average BNP concentration in patients with severe diastolic dysfunction at rest was 188.3 vs. 25.2 pg/mL in patients with normal diastolic function ($p < 0.001$). In all patients with severe diastolic dysfunction BNP after exercise was 285.2 vs. 37.5 pg/mL in patients with normal diastolic function, and the increase in BNP during exercise was 96.9 vs. 12.4 pg/mL, respectively. Duration of exercise and exercise tolerance in patients with normal diastolic function was better in comparison with the studied patients with disturbed diastolic function, but did not reach statistical significance.

Conclusions: The BNP initial concentration and its value immediately after exercise were significantly higher in subjects with severe diastolic disorders than those in subjects with normal LV diastolic function and in subjects with impaired LV relaxation.

Key words: left ventricular diastolic function, B-type natriuretic peptide, exercise test

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INTRODUCTION

Clinical evaluation of patients with diabetes or after myocardial infarction (MI) with preserved left ventricular (LV) systolic function is not very precise in isolation of patients particularly at risk of developing manifest cardiac failure and associated cardiovascular incident.

Left ventricular diastolic dysfunction (LVDD) with preserved ejection fraction (EF) without accompanying clinical symptoms is the first stage of diabetic cardiomyopathy and link in the pathogenesis of LV remodelling after MI [1, 2]. Early diagnosis of LVDD is essential because implementation of appropriate treatment can positively affect the course of the disease. Doppler and tissue echocardiography remains the most widely used non-invasive method of assessing LV diastolic function. It enables precise positioning of several stages of diastolic dysfunction [3].

For the evaluation of LV diastolic function, measuring the strain rate and stress echocardiography can be used.

Also, B-type natriuretic peptide (BNP) has an established position in the detection of asymptomatic LVDD, and its level is proportional to the severity of LVDD [4, 5].

Stress test is a clinically useful method of assessing exercise tolerance and assessing the risk of ischaemia. Using three diagnostic methods: echocardiography, stress test, and measuring concentrations of natriuretic peptides allows for more accurate assessment of patients and allows for more effective treatment.

Low BNP concentrations have a high negative predictive value at the exclusion of heart failure (HF). The BNP cut-off value in patients with acute dyspnoea is below 100 pg/mL and in patients with a slow development of cardiac failure symptoms, BNP levels < 35 pg/mL [3].

B-type natriuretic peptide is a neurohormone synthesised by the myocardium and released in response to myocardial wall stretch due to increased volume or intracardiac pressure. BNP plays a role in preventing volume overload through the renin–angiotensin–aldosterone system inhibition, and it has natriuretic, diuretic and vasodilating effects [6].

Survival of patients with type 2 diabetes without MI is similar to patients without diabetes after MI [7]. It was in the Framingham study, for the first time, that an association between diabetes and HF was found [8]. Data from the Framingham study showed that the mortality rate in LVDD is 8.9% compared with 3.7% in the control group. Consequently, diabetics should be treated as a very high cardiovascular risk group requiring secondary prevention.

In connection with a similar prognosis of patients with diabetes and patients after MI without diabetes, it was decided to compare the subjects in those two groups.

The aim of the study was to assess the impact of LV diastolic function on BNP concentration at rest and immediately after stress test and to search for the relationship between LV diastolic function and BNP secretion, and tolerance and duration of exercise in the studied groups of patients.

METHODS

Study group

Subjects qualified for the study were patients with type 2 diabetes without a history of MI (Group 1) and patients after MI treated with primary angioplasty, with preserved LV systolic function (EF ≥ 40%) in the period from three months to one year after acute MI (Group 2). The exclusion criteria of the study were: LVEF < 40%, valvular heart disease, also after adjustment, atrial fibrillation, and acute MI within three months after the MI.

The study included 99 patients aged 40–75 years: 39 patients with diabetes and 60 with a history of acute MI. All patients had preserved LV systolic function (LVEF ≥ 40%).

The patients currently did not have symptoms of cardiac failure, were undergoing optimal medical therapy, and diabetes was controlled. Medication of the studied patients: angiotensin converting enzyme inhibitors (ACEI) — 71 (72%), sartans — 8 (8%), beta-blockers — 42 (%), statins — 69 (70%), diuretics — 14 (14%), insulin — 24 (24%), oral hypoglycaemics — 25 (25%), acetylsalicylic acid (ASA) — 64 (65%). Some cardiology drugs (diuretics, ACEI, beta-blockers) may reduce BNP levels, but their percentage distribution was proportional in the study groups.

The patients included in the study were a group of outpatients in the Regional Diabetes Clinic and in the Clinical Department of the Swietokrzyskie Cardiology Centre.

The study was approved by the Bioethics Committee of the Medical Chamber of Kielce No. 11/2005. All the subjects were previously informed in detail about the study purpose and method, and a signed written consent to participate in the research was obtained from each patient.

Echocardiography

Left ventricular diastolic function assessment was done based on echocardiography with the following parameters determination: mitral inflow profile (peak E wave velocity [E], the maximum speed of A wave [A], E/A ratio, E wave deceleration time [DT]) and tissue Doppler parameters (early diastolic mitral annulus velocity e'), as well as the E/e' index — the ratio of the maximum velocity of early mitral inflow to early diastolic mitral annulus velocity. In order to distinguish normal from pseudonormal inflow profile, the pulmonary veins flow profile was analysed (the S/D ratio, the amplitude of the Ar wave [Ar-atrial reversal], and the difference between the duration of wave A inflow in the pulmonary vein, and mitral inflow wave A duration [Ar-A]) and the change of the E/A ratio during the Valsalva manoeuver (Val ΔE/A).

The following criteria of LVDD diagnosis were adopted [3, 9]:

- normal LV diastolic function (e'septal ≥ 8, left atrial volume index < 34 mL/m^2);
- mild diastolic dysfunction (grade I): e'septal < 8, E/A < 0.8, DT > 200 ms, E/e' ≤ 8, Ar-A < 0 ms, Val ΔE/A < 50%;
- severe diastolic dysfunction (grade II and III):

Table 1. Echocardiography parameters

Parameter tested	Study group (n = 99)		P
	Subjects after myocardial infarction (n = 60)	Diabetics (n = 39)	
E [cm/s]	66.0 ± 21.3	62.6 ± 14.5	0.35
A [cm/s]	77.2 ± 17.8	74.2 ± 16.8	0.39
E/A ratio	0.9 ± 0.4	0.9 ± 0.4	0.89
Deceleration time [ms]	226.5 ± 57.8	232.3 ± 82	0.70
e' septal [cm/s]	7.5 ± 2.7	7.2 ± 2.6	0.55
E/e' index	9.8 ± 5.7	9.6 ± 3.4	0.87
Left atrial volume index [mL/m^2]	35.3 ± 2.8	35.8 ± 4.7	0.88
Ejection fraction [%]	51.2 ± 6.4	61.9 ± 3.9	< 0.001

Data are presented as mean ± standard deviation; E — maximum E wave velocity; A — maximum A wave velocity; e' septal — early diastolic mitral annulus velocity; E/e' index — the ratio of the maximum velocity of early mitral inflow to early diastolic mitral annulus velocity

- pseudonormalisation of mitral inflow: e'septal < 8, E/A 0.8–1.5, DT 160–200 ms, E/e' 9–12, Ar-A ≥ 30 ms, Val ΔE/A ≥ 50%;
- restrictive mitral inflow: e'septal < 8, E/A ≥ 2, DT < 160 ms, E/e' ≥ 13, Ar-A ≥ 30 ms, Val ΔE/A ≥ 50%.

Left ventricular hypertrophy (LVH) was diagnosed on the basis of septal thickness (IVS) in the long-axis parasternal view (IVS ≥ 12 mm).

Stress test

The stress test was performed on a treadmill, according to the Bruce protocol, with the use of a Marquette Electronics Case 8000 treadmill. Immediately before and after the test, the concentrations of BNP were determined.

Blood pressure (BP) and heart rate (HR) were taken at rest and immediately after maximal exercise. The test was terminated once the studied age-appropriate submaximal HR was achieved or fatigue or symptoms of angina with ST-segment depression on electrocardiogram were present.

Biochemical assays

Blood samples for determination of resting BNP were collected from the antecubital vein after 30 min of rest before performing the stress test, and immediately after the test. Plasma BNP was determined by enzyme immunoassay, and the measurement was performed on an automated analyser. BNP concentrations were determined using the Beckman Coulter Immunoassay system.

Statistical analysis

The statistical description of quantitative variables was made with the use of the mean, the standard deviation (SD), and the median. Qualitative variables were characterised by specifying the size of each of the variants and its percentage of the group under consideration. For comparison of the mean values of the quantitative variable in both groups the Student's t-test was used. For a larger number of groups, the F test of analysis of variance as well as the Tukey and Duncan multiple comparison tests were applied. The nonparametric analysis of variance and the Kruskal-Wallis tests were used when the distribution of a quantitative variable showed a significant deviation from the normal distribution. To compare groups of patients in terms of a qualitative variable the χ^2 independence test was used.

In statistical inference the significance level of 0.05 was adopted. Statistical analyses were performed using SAS 9.3 licensed software.

RESULTS

The study included 99 consecutive patients after MI, without diabetes, and with EF ≥ 40% (Group 1), as well as patients with type 2 diabetes, without a history of MI (Group 2).

Table 1 presents LV diastolic function parameters in the study group. Diastolic dysfunction occurred in 41 (68.4%) patients in the group after MI, and in 21 (53.8%) patients in the group with diabetes; severe disorders in the form of pseudonormal and restrictive mitral valve inflow occurred in 13 (21.7%) vs. 5 (12.8%) (Table 2).

In patients with diabetes and after MI with preserved LV systolic function, BNP secretion increase was demonstrated during the exercise test.

The difference of the average BNP increase in the whole group and in the groups after MI and with diabetes was statistically significant ($p < 0.001$). The ends of the confidence intervals for the mean increase in BNP, obtained for a confidence level of 0.95, were as follows: the entire group — 1.98; 38.14, the diabetes group — 9.41; 26.80, patients after MI — 5.98; 49.68.

B-type natriuretic peptide concentration before the stress test for the entire group was 63.1 ± 83 pg/mL, at peak

Table 2. Assessment of left ventricular (LV) diastolic function in study groups

LV diastolic function	Study group (n = 99)		P
	Subjects after myocardial infarction (n = 60)	Diabetics (n = 39)	
Normal	19 (31.7%)	18 (46.2%)	0.28
Mildly impaired	28 (46.7%)	16 (41.0%)	
Severely impaired	13 (21.7%)	5 (12.8%)	

Table 3. B-type natriuretic peptide (BNP) concentrations in study groups

	Subjects after myocardial infarction (n = 60)	Diabetics (n = 39)	P*
BNP before exercise test [pg/mL]	71.1 ± 93.8	51.0 ± 62.4	0.20
BNP after exercise test [pg/mL]	108.9 ± 133.2	69.1 ± 80.9	0.07
Growth of BNP [pg/mL]	37.8 ± 45.9	18.1 ± 26.8	0.01

Data are presented as mean ± standard deviation; *p — multiple comparison test

Table 4. B-type natriuretic peptide (BNP) concentrations in the whole study group

	Normal diastolic function (n = 37)	Mildly impaired (n = 44)	Severely impaired (n = 18)	P*
BNP before exercise test [pg/mL]	25.2 ± 18.8	43.9 ± 27.1	188.3 ± 128.3	< 0.001
BNP after exercise test [pg/mL]	37.5 ± 21.7	61.5 ± 35.6	285.2 ± 160.8	< 0.001
Growth of BNP [pg/mL]	12.4 ± 9.7	17.6 ± 16.2	96.9 ± 52.7	< 0.001

Data are presented as mean ± standard deviation; *p — multiple comparison test

Table 5. B-type natriuretic peptide (BNP) concentrations in the group with diabetes

	Normal diastolic function (n = 18)	Mildly impaired (n = 16)	Severely impaired (n = 5)	P*
BNP before exercise test [pg/mL]	26.0 ± 22.2	48.1 ± 36.8	150.0 ± 121.3	< 0.001
BNP after exercise test [pg/mL]	37.8 ± 25.3	59.6 ± 44.4	223.2 ± 129.4	< 0.001
Growth of BNP [pg/mL]	8.8 ± 6.9	11.4 ± 9.6	73 ± 44.0	< 0.001

Data are presented as mean ± standard deviation; *p — multiple comparison test

exercise 93.2 ± 116.6 pg/mL, and the mean BNP increase was 30.1 ± 40.5 pg/mL.

B-type natriuretic peptide concentration before the stress test in the group with a history of MI was 71.1 ± 93.8 pg/mL, and in the group with diabetes 51.0 ± 62.4 pg/mL.

The average BNP concentration after exercise and BNP increase during exercise were higher in patients after MI. The exercise resulted in an average BNP increase in subjects after acute MI of 37.8 ± 45.9 pg/mL and in subjects with diabetes, 18.1 ± 26.8 pg/mL (Table 3).

The average BNP concentrations at rest and at peak exercise, as well as BNP increase during the exercise, were significantly higher in subjects with severe diastolic dysfunction. The average concentrations of BNP in subjects with severe diastolic dysfunction at rest amounted to 188.3 vs. 25.2 pg/mL in patients with normal LV diastolic function, and immediately after exercise 285.2 vs. 37.5 pg/mL. The increase in BNP during exercise was 96.9 vs. 12.4 pg/mL (Table 4).

Both in patients with diabetes and in those with MI the average concentrations of BNP were significantly higher in subjects with severe diastolic dysfunction. Relationships between LV diastolic function and BNP in the group with diabetes are shown in Table 5, and in the group after MI in Table 6.

Severe abnormality in diastolic function was observed more frequently in older patients ($p = 0.05$) and in subjects with EF < 50% ($p < 0.001$). Duration of exercise and exer-

Table 6. B-type natriuretic peptide (BNP) concentrations in the group after myocardial infarction

	Normal diastolic function (n = 19)	Mildly impaired (n = 28)	Severely impaired (n = 13)	P
BNP before exercise test [pg/mL]	24.4 ± 15.4	41.5 ± 19.9	203.0 ± 132.7	< 0.001
BNP after exercise test [pg/mL]	40.2 ± 18.0	62.6 ± 30.3	309.1 ± 169.7	< 0.001
Growth of BNP [pg/mL]	15.8 ± 10.8	21.1 ± 16.2	106.1 ± 54.4	< 0.001

Data are presented as mean ± standard deviation; *p — multiple comparison test

Table 7. The relationship between left ventricular diastolic function and selected parameters in the whole study group

Parameter	Normal diastolic function (n = 37)	Mildly impaired (n = 44)	Severely impaired (n = 18)	P*
Age [years]	53.5 ± 6.5	55.6 ± 8.0	58.7 ± 6.9	0.05
Age > 60 years	61.8 ± 1.2	65.3 ± 0.8	72.2 ± 1.1	0.001
Body mass index	28.3 ± 4.0	28.4 ± 4.3	28.4 ± 3.5	0.99
Ejection fraction [%]	59.0 ± 6.2	55.4 ± 6.4	48.2 ± 8.3	< 0.001
Metabolic equivalent of task	8.8 ± 2.1	8.0 ± 2.4	8.2 ± 2.5	0.26
Exercise time [min]	7.1 ± 2.1	6.3 ± 2.3	6.5 ± 2.6	0.32
HR at rest [bpm]	78.2 ± 10.8	81.5 ± 17.6	73.3 ± 16.7	0.15
HR max [bpm]	134.8 ± 19.5	133.0 ± 14.1	128.7 ± 17.9	0.45
Max systolic BP [mm Hg]	165.1 ± 23.3	163 ± 22.9	169 ± 28	0.67
ST depression	6 (16.3%)	11 (25%)	5 (27.8%)	0.52
Smoking	15 (40.5%)	14 (31.8%)	6 (33.3)	0.70
Arterial hypertension	24 (64.9%)	32 (72.7 %)	13 (72.2%)	0.72
Hypercholesterolaemia	24 (64.9%)	32 (72.7%)	13 (72.2%)	0.93
Left ventricular hypertrophy	5 (13.5%)	24 (54.5%)	7 (38.9%)	< 0.001

Data are presented as mean ± standard deviation or number and percentage (in brackets); BP — blood pressure; HR — heart rate; *p — multiple comparison test

cise tolerance (expressed in METS) in subjects with normal diastolic function was better in comparison with the studied patients with impaired diastolic function, but it did not reach statistical significance. In the study group hypertension occurred in 29 (74.4%) patients with diabetes and in 40 (66.7%) patients with a history of MI ($p = 0.41$). LVH was present in 13 (33.3%) patients with diabetes and in 23 (38.3%) after MI ($p = 0.61$). There was a statistically significant impact of LVH on LV diastolic dysfunction ($p < 0.001$). Among the risk factors for cardiovascular disease, hypertension and hypercholesterolaemia were more frequent in subjects with impaired diastolic function compared to subjects with normal function (Table 7).

DISCUSSION

Left ventricular diastolic dysfunction, due to the asymptomatic nature at its early stage, is usually not diagnosed or treated, which leads to progressive myocardial injury, the development of manifest cardiac failure, and associated cardiovascular events. Early diagnosis of diastolic dysfunction of the LV is important, since the implementation of appropriate treatment may favourably affect the prognosis [10].

Kato et al. [11] compared the BNP response to exercise in patients with asymptomatic LV dysfunction, in patients with cardiac failure and in the control group. The authors demonstrated that the absolute increase, and more importantly the BNP increase adjusted for increase in load (determined by the ratio of the increase in BNP to the increase in maximum oxygen uptake during exercise), was higher with LV dysfunction and significantly higher in patients with cardiac failure [11].

In the presented study, the mean concentrations of BNP at rest and at peak exercise, as well as the BNP increase during exercise, were significantly higher in subjects with severe diastolic dysfunction.

Several scientific studies evaluated the value of BNP in the diagnosis of diastolic dysfunction compared with conventional echocardiography. Significantly higher levels of BNP and NT-proBNP were detected in patients with advanced diastolic dysfunction. However, it was found that these peptides correlate with severe diastolic dysfunction, while their

role in detecting moderate diastolic HF is uncertain. Lubien et al. [12] found that BNP levels were elevated in patients with exertional dyspnoea and impaired LV relaxation (202 pg/mL).

Mottram et al. [13] also found increased BNP levels in patients with hypertension induced LV relaxation disorders as compared with the control group; however, the BNP levels of over 75% of patients with impaired relaxation participating in this study were within the normal range (89 pg/mL).

Hypertension can lead to HF through increased afterload, LVH, fibrosis, and impaired LV diastolic filling. Diastolic dysfunction assessed by echocardiography is an independent factor for the development HF and sudden cardiac death [14].

Wei et al. [15] indicated low but significantly elevated levels of BNP in diastolic dysfunction caused by hypertension, which showed moderate sensitivity but high specificity in detecting diastolic dysfunction in hypertensive patients. Similarly, Dahlstrom [16] demonstrated only a tendency towards elevated levels of both BNP and NT-proBNP in patients with minor alterations of diastolic dysfunction indices in Doppler echocardiography. Also, Tschope et al. [17] demonstrated that the concentration of NT-proBNP was elevated in patients with diastolic dysfunction and preserved systolic function and correlated with the severity of the disease.

Levels of NT-proBNP showed similar diagnostic accuracy for diastolic HF as measured by tissue Doppler imaging, and they were a better diagnostic parameter of diastolic dysfunction than conventional echocardiography [17].

Left ventricular diastolic dysfunction with preserved systolic function without accompanying clinical symptoms may be the first stage of diabetic cardiomyopathy. In the Strong Heart Study diabetes associated LVDD was similar to that associated with hypertension, but it was more severe in patients with both diseases [18].

Depending on the echocardiographic criteria used in the definition, LVDD is found in 30–75% of diabetics [19]. Boyer et al. [20] diagnosed diastolic dysfunction in 47% of asymptomatic patients with type 2 diabetes but with normal blood pressure values, while Valle et al. [21] documented subclinical LV diastolic dysfunction in 51.3% of diabetics with normal LV systolic function.

In the presented study diastolic dysfunction occurred in 53.8% of diabetics, and in the group after MI 68.4% had abnormal diastolic function, including 13% with severe disorders. Diastolic dysfunction was significantly more frequent in subjects with LVH. In the population study Hurk et al. [22] showed that in asymptomatic patients with type 2 diabetes, elevated concentrations of BNP, but below the threshold of 100 pg/mL, were significantly associated with increased LV mass and deterioration of its diastolic function, independent of cardiovascular disease traditional risk factors. In the present study, BNP concentration in patients with diabetes and severe diastolic dysfunction was 150 pg/mL and was significantly higher than in subjects with normal diastolic function or mild diastolic dysfunction. Similar results were obtained by Magnusson et al. [23], who demonstrated that the BNP level determination proved to be useful for the identification of patients with severe diastolic dysfunction. Impaired relaxation can be a symptom of myocardial ischaemia due to limited supply of energy. According to Apstein et al. [24], ischaemia caused by increased demand for oxygen provokes diastolic dysfunction. The significant improvement in diastolic filling in patients undergoing coronary revascularisation confirms the importance of ischaemia in the pathogenesis of the diastolic dysfunction. Deterioration of energy substrate-dependent active relaxation, reduction of compliance as a result of fibrotic changes, heterogeneity of load, and the inactivation caused by segmental abnormalities in LV systolic and diastolic function are of major importance in the mechanism of diastolic dysfunction in ischaemic heart disease.

In the present study, severe diastolic dysfunction was more frequent in older subjects. Boonman-de Winter et al. [25] demonstrated that 28% of type 2 diabetics, aged > 60 years, had previously undetected HF, 5% of whom had reduced LVEF, and 23% had preserved LVEF [25]. In heart failure with preserved ejection fraction (HF-PEF) patients, age was considered to be one of the most important prognostic factors. The five-year mortality rate in patients with HF-PEF aged < 50 years was 15%. In patients aged 50–70 years the rate was 33%, and in the group over 70 years of age it exceeded 50% [10]. Also, the Digitalis Investigation Group study demonstrated older age as an important predictor of mortality in HF-PEF patients [10].

Limitations to the study

An undoubted limitation to the study is the small number of patients in the study groups. In the assessment of LV diastolic function strain rate was not used and neither was stress echocardiography, due to the lack of universally accepted criteria for diagnosis of diastolic dysfunction using these parameters and lack of data defining their diagnostic accuracy.

CONCLUSIONS

1. B-type natriuretic peptide concentration was significantly higher in subjects with severe diastolic dysfunction as compared with subjects with normal diastolic function and subjects with impaired LV relaxation.
2. The concentration of BNP at peak exercise, as well as the increase in BNP during the exercise, was significantly higher in subjects with severely impaired diastolic function.
3. Duration and exercise tolerance were worse in patients with impaired diastolic function, compared with those in the study patients with normal diastolic function, but they did not reach statistical significance.

Conflict of interest: *none declared*

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Wpływ czynności rozkurczowej lewej komory na wydzielanie peptydu natriuretycznego typu B w spoczynku i bezpośrednio po próbie wysiłkowej u bezobjawowych pacjentów z cukrzycą oraz po przebytym zawale serca z zachowaną funkcją skurczową lewej komory

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Streszczenie

Wstęp: Kliniczna ocena chorych na cukrzycę lub po przebytym zawale serca z zachowaną funkcją skurczową lewej komory (LV) jest mało precyzyjna w wyodrębnianiu osób szczególnie zagrożonych rozwojem jawnej niewydolności serca czy incydentem sercowo-naczyniowym. Dysfunkcja rozkurczowa LV z zachowaną funkcją skurczową bez towarzyszących objawów klinicznych może stanowić pierwszy etap kardiomiopatii cukrzycowej i ogniwo w patogenezie remodelingu LV po przebytym zawale serca. Wczesne rozpoznanie rozkurczowej dysfunkcji LV ma istotne znaczenie, ponieważ wdrożenie odpowiedniego postępowania może korzystnie wpłynąć na przebieg choroby. Echokardiografia doplerowska i tkankowa pozostają najpowszechniej stosowanymi nieinwazyjnymi metodami oceny czynności rozkurczowej LV. Umożliwiają precyzyjne wyróżnienie kilku stadiów dysfunkcji rozkurczowej. Peptyd natriuretyczny typu B (BNP) ma ugruntowaną pozycję w wykrywaniu bezobjawowych zaburzeń czynności rozkurczowej LV, a jego stężenie jest proporcjonalne do stopnia zaawansowania zaburzeń czynności rozkurczowej. BNP to neurohormon syntetyzowany przez mięśniówkę komór i uwalniany w odpowiedzi na rozciągnięcie ściany miokardium na skutek zwiększonej objętości czy ciśnienia wewnątrzsercowego. BNP odgrywa rolę w zapobieganiu przeciążeniu objętościowemu poprzez zahamowanie układu renina–angiotensyna–aldosteron, działa natriuretycznie, moczopędnie i rozszerza naczynia krwionośne. Obecność dysfunkcji rozkurczowej LV po zawale serca może się wiązać z występowaniem remodelingu, niewydolności serca i pogorszeniem rokowania w tej grupie chorych, niezależnie od upośledzonej funkcji skurczowej LV. Cukrzyca stanowi niezależny czynnik ryzyka rozwoju niewydolności serca. Jest coraz więcej doniesień wskazujących na istotną rolę peptydów natriuretycznych w wykrywaniu bezobjawowych zaburzeń czynności rozkurczowej LV oraz w stratyfikacji ryzyka u tych pacjentów.

Cel: Celem badania była ocena wpływu funkcji rozkurczowej LV na stężenie BNP w spoczynku i bezpośrednio po zakończeniu próby wysiłkowej oraz poszukiwanie zależności między funkcją rozkurczową LV a wydzielaniem BNP, tolerancją i czasem trwania wysiłku w badanych grupach chorych.

Metody: Do badania kwalifikowano kolejnych pacjentów z cukrzycą typu 2 bez wywiadu zawału serca oraz chorych po przebytym zawale serca z zachowaną funkcją skurczową LV (EF ≥ 40%). Wykonywano badanie echokardiograficzne z oceną funkcji skurczowej i rozkurczowej LV, elektrokardiograficzną próbę wysiłkową oraz pobierano krew w celu oznaczenia BNP przed testem wysiłkowym i bezpośrednio po nim.

Wyniki: Do badania włączono 99 pacjentów w wieku 40–75 lat (60 osób po zawale serca i 39 chorych na cukrzycę); zaburzenia funkcji rozkurczowej rozpoznawano u 62 badanych. W grupie po przebytym zawale serca u 41 (68,4%) osób występowały zaburzenia funkcji rozkurczowej, a w grupie pacjentów z cukrzycą — u 21 (53,8%) badanych, w tym ciężkie zaburzenia u 13 (21,7%) *vs.* 5 (12,8%) odpowiednio pod postacią pseudonormalnego i restrykcyjnego napływu mitralnego. Średnie stężenie BNP u chorych z ciężkimi zaburzeniami funkcji rozkurczowej w spoczynku wynosiło 188,3 pg/ml *vs.* 25,2 pg/ml u badanych z prawidłową funkcją rozkurczową LV ($p = 0,0001$). Czas trwania próby i tolerancja wysiłku (METS) u badanych z prawidłową funkcją rozkurczową były lepsze niż u osób z zaburzeniami funkcji rozkurczowej, ale nie osiągnęły istotności statystycznej.

Wnioski: Stężenie BNP wyjściowe oraz bezpośrednio po zakończeniu wysiłku było istotnie wyższe u badanych z ciężkimi zaburzeniami funkcji rozkurczowej w porównaniu z pacjentami z prawidłową funkcją rozkurczową LV i z osobami z upośledzoną relaksacją.

Słowa kluczowe: funkcja rozkurczowa lewej komory, peptyd natriuretyczny typu B, próba wysiłkowa

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