

Effects of exercise testing on natriuretic peptide secretion in patients with atrial fibrillation

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Abstract

Background: Assessment of endocrine profile in patients with cardiovascular diseases has become increasingly important during the last decade. Plasma brain natriuretic peptide (BNP) levels have been used as a marker of left ventricular dysfunction. However, the role of BNP in patients with atrial fibrillation (AF) and normal left ventricular function has not yet been determined.

Aim: To examine changes in the secretion of natriuretic peptides (atrial natriuretic peptide – ANP and BNP) during exercise in patients with persistent or permanent AF.

Methods: The study group consisted of 42 patients with permanent AF and 77 patients with persistent AF. There were no significant differences in baseline clinical (except AF duration), echocardiographic and haemodynamic data between the groups. The control group comprised 20 patients. All had normal sinus rhythm without a history of AF and were compatible in age, gender and concomitant diseases with the examined groups. The ANP and BNP samples were obtained at rest and at the peak of the exercise testing. Duration of exercise testing was 10 min.

Results: The multiple regression analysis showed an association between ANP levels and left atrial volume ($p = 0.0001$), maximal heart rate ($p = 0.0036$) and NYHA class ($p < 0.0001$). There was a trend toward a significant relation between AF duration and ANP levels. There was a significant correlation between BNP levels and heart failure class according to NYHA ($p < 0.0001$). A significant and strong positive correlation of ANP and BNP concentrations at rest was observed in all groups of AF. Significant variation of natriuretic peptide release in response to exercise (ANP_{ex} and BNP_{ex}) was observed. The highest increase of ANP level and the lowest increase of BNP level were noted in the control group, and no significant differences were found in ANP and BNP secretion between the groups with persistent and permanent AF.

Conclusions: Neurohormonal response to exercise differs between patients with AF and those in sinus rhythm. Exercise testing may be used to assess the ability of cardiac myocytes to increase peptide secretion.

Key words: atrial fibrillation, natriuretic peptide, exercise testing

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Introduction

Natriuretic peptides, which are among the most promising biomarkers in cardiology, are a part of the neuroendocrine system, which acts together with other neurogenic, humoral and structural factors in the regulation of the cardiovascular system. Initially, they were used to establish the severity of damage of the heart and to assess how advanced is the pathology of the cardiovascular system. Nowadays, they play a role in risk stratification, and they help to choose the appropriate therapy and to determine prognosis. Although natriuretic peptides are sensitive markers

of haemodynamic status, little is known about the effects of exercise on the secretion of atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP) in patients with atrial fibrillation (AF). Although since 1981, when Adolfo de Bold discovered ANP and determined its action, many multidisciplinary studies have been performed to expand the knowledge about biological effects of natriuretic peptides, their role remains to a large degree unknown. Moreover, the opinion about the role of natriuretic peptides in pathophysiological processes is changing [1].

Natriuretic peptides ANP and BNP are synthesised in cardiac myocytes: ANP mainly in the atria and BNP mainly in the heart ventricles in response to volume and pressure

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overload. In the blood pool both active C-terminal peptides and N-terminal fragments of prohormones can be found. The assessment of the secretion reserve of cardiac myocytes in patients with AF during exercise may be an important part of the diagnostic and therapeutic process in this population.

Methods

A group of adult patients with persistent or permanent AF treated in the cardiology department and fulfilling inclusion criteria was studied. Patients were classified in the group of persistent or permanent AF according to European Society of Cardiology guidelines [2]. In the group of patients with persistent AF sinus rhythm restoration was acquired with direct-current cardioversion. Patients with unsuccessful sinus rhythm restoration in the history and patients in whom sinus rhythm restoration was not attempted and not planned were classified in the group of permanent AF. Patients without a history of AF, with sinus rhythm matched according to age, gender and cardiovascular comorbidities, served as controls.

The inclusion criteria were as follows:

- age between 40 and 75 years,
- presence of AF: persistent or permanent,
- heart rate < 90 beats per minute (bpm) at rest,
- no signs and symptoms of heart failure or stable heart failure in NYHA class II or less,
- left ventricular ejection fraction $\geq 45\%$ as assessed with echocardiographic study,
- ability to perform exercise during stress test on a treadmill,
- written consent to participate in the study.

The exclusion criteria included:

- pregnancy,
- congenital or acquired heart disease,
- poorly controlled hypertension,
- heart rate ≥ 90 bpm at rest during AF,
- sinus node insufficiency, atrioventricular conduction disturbances (heart rate < 60 bpm with AF and without any medications influencing atrioventricular node conduction),
- heart failure in NYHA class > II,
- significant enlargement of heart chambers in echocardiographic study (LA > 60 mm, LV_{diastole} > 65 mm, LV_{systole} > 45 mm),
- left ventricular ejection fraction < 45% as assessed with echocardiographic study,
- acute inflammatory states,
- thyroid function abnormalities,
- electrolyte disturbances,
- acute coronary syndrome < 6 weeks, CABG < 3 months, stroke < 3 months,
- diabetes,
- renal insufficiency, hepatic insufficiency, pulmonary insufficiency,

- central nervous system injury,
- alcohol abuse,
- pulmonary embolism, pulmonary hypertension,
- anaemia with haemoglobin < 11 g, haematocrit < 0.37,
- contraindications to antithrombotic treatment,
- patient's refusal to participate in the study.

Electrocardiographic exercise test

Electrocardiographic exercise test was performed according to the modified Bruce protocol [3]. The study was performed within 10 min. The study was performed with a Marquette Electronics Case 8000 treadmill (Marquette Medical Systems, Inc., Milwaukee, WI, USA). The test was terminated when a persistent (lasting longer than 1 min) target heart rate (i.e. maximal limit for age) was achieved or when symptoms of severe fatigue or one of the criteria for study termination occurred [3-5].

The criteria for test termination were as follows:

- anginal pain,
- exacerbation of heart failure symptoms,
- excessive blood pressure (BP) increase: systolic BP > 200 mmHg and/or diastolic BP > 120 mmHg,
- hypotension,
- dyspnoea, cyanosis, pallor,
- ventricular arrhythmia (more severe than class III according to Lown),
- bundle branch blocks,
- general fatigue,
- pain in lower extremities,
- vision abnormalities, vertigo
- patient's will to terminate the test.

On the day when the study was performed, the patient received the morning medications and a small meal. Patients were on antihypertensive treatment (angiotensin-converting enzyme inhibitors, sartans, calcium channel blockers, diuretics), rate control medications (beta-blockers, digoxin) and antithrombotic treatment. There were no significant differences in treatment between studied groups. Resting blood pressure and resting heart rate were measured before the exercise test. During the test heart rate and blood pressure were obtained every 1 min. After exercise ECG was monitored continuously and heart rate and blood pressure were measured 1, 2, 5 and 10 min after exercise termination.

Natriuretic peptide levels

Blood samples for ANP and BNP concentration analysis were drawn from the antecubital vein, after 30 min rest in the supine position for pretest concentrations; the second sample was obtained immediately after exercise termination. Blood samples were placed in tubes containing ethylenediaminetetraacetic acid (EDTA) with aprotinin 500 KI/ml (Traskolan, Jelfa, Jelenia Góra, PL). After centrifugation at a temperature of 4°C serum was frozen at -70°C. Before analysis samples were extracted using

ion-exchange chromatography (columns C18, Peninsula Lab. Inc.) in order to achieve higher peptide concentrations and to obtain blood plasma.

The ANP and BNP concentrations in plasma samples were determined using specific radio-immuno-assay (RIA) kits from Peninsula Lab. Inc. (Peninsula Laboratories Inc., San Carlos, CA, USA): human S-2039 (RIK 9103) for alpha-ANP and 32 human S-2016 (RIK 9086) for BNP according to the manufacturer's instructions. The study was performed in compliance of the procedures of work with radioactive substances. Intra-assay and inter-assay coefficients of variation were 7.1% and 11.1% for ANP respectively, and for BNP: 5.6% and 9.0% respectively.

The study was approved by the local ethics committee (approval number 8/2002).

Statistical analysis

Variables are expressed as means $\pm$ standard deviation or with standard error when t-test for paired samples was used. Pooled Student's t-test was used for independent samples with equal variances and normal distribution. The Satterthwaite test was used for independent samples with unequal variances and normal distribution. Categorical variables were compared using the χ^2 test. Matched-pair analysis (t-test for paired samples) was performed to compare mean values of the variables changing in time in the same patient. For comparisons between mean values in more than two groups analysis of variance and F-test were used. If any significant difference was found the comparison was made using Duncan's and Tukey's methods. Correlations between two variables were performed using Pearson and Spearman correlation coefficient. A p value < 0.05 was considered significant.

Results

Baseline characteristics of the studied groups are presented in Table I. Results of the echocardiographic study are shown in Table II. The multiple regression analysis showed an association between ANP levels and left atrial volume ($p = 0.0001$), maximal heart rate ($p = 0.0036$) and NYHA class ($p < 0.0001$). There was a trend toward a significant relationship between AF duration and ANP levels. There was a significant correlation between BNP levels and heart failure class according to NYHA ($p < 0.0001$). A significant and strong positive correlation between ANP and BNP concentrations at rest was observed in all groups of AF. The duration of exercise was 10 minutes with the mean metabolic equivalent (MET) of 6.1 ± 0.4 MET. All patients performed the whole test. Significant variation of natriuretic peptide release in response to exercise (ANP_{ex} and BNP_{ex}) was observed (Table III). The highest ANP_{ex} level immediately after termination of exercise was noted in the group of persistent AF, the highest absolute increase in the group of permanent AF, respectively (Table III). On the other hand, the highest relative (in comparison to rest concentration) increase of ANP levels was observed in the control group (80%). Patients with permanent AF had the highest BNP_{ex} levels after exercise termination, and they also had the highest absolute and relative exertional BNP concentration increase (Table III, Figure 1). The lowest absolute and relative increase in BNP concentrations in response to exercise was noted in the control group (Table III, Figure 2). Mean increase in ANP concentration (Δ ANP) on exertion was 22 times more pronounced than the mean increase of BNP levels (Δ BNP) in controls as compared with 5-fold and 4-fold differences in the group of persistent and permanent AF respectively. The highest

Table I. Baseline characteristics of the studied groups of patients

Characteristic	Persistent AF n = 77	Permanent AF n = 42	Control group n = 20	p
Gender [male/female]	52/25 (68%)	27/15 (64%)	13/7 (65%)	
Age [years]	59.8 $\pm$ 9	64.3 $\pm$ 7.7	61.8 $\pm$ 8.1	NS (0.077)
Duration of AF [months]	3.4 $\pm$ 3.3	46.7 $\pm$ 13.9	–	
BMI [kg/m ²]	27.1 $\pm$ 2.5	28.1 $\pm$ 2.4	26.5 $\pm$ 2.5	NS (0.082)
Comorbidities [%]				
hypertension	51 (66)	16 (62)	13 (65)	NS (0.22)
coronary artery disease	16 (21)	11 (26)	7 (35)	
lone AF	10 (13)	5 (12)	–	
BP ₀ [mmHg]	123 $\pm$ 16	131 $\pm$ 15	129 $\pm$ 15	NS
HR ₀ [cykl/min]	82.5 $\pm$ 9	81 $\pm$ 8.1	71 $\pm$ 7	NS
Mean class according to NYHA	1.39 $\pm$ 0.7	1.33 $\pm$ 0.7	1.40 $\pm$ 0.5	NS (0.31)
No symptoms of HF [%]	35 (46)	23 (55)	12 (60)	
NYHA class II	42 (54)	19 (45)	8 (40)	

Abbreviations: BP₀ – systolic blood pressure before exercise test, HR₀ – mean blood pressure before exercise test, HF – heart failure

Table II. Baseline echocardiographic characteristic of patients with persistent or permanent AF, and control group

Parameter	Persistent AF n = 77	Permanent AF n = 42	Control group n = 20	p
LA _{ap} [mm]	46.3 ± 4	47.5 ± 5.3	45.2 ± 2.7	NS (0.204)
LA _{vol} [ml]	88.2 ± 20	110.0 ± 35.6	78.3 ± 11.6	< 0.0001*
LV _{diast} [mm]	50.8 ± 6	52.3 ± 5.8	51.7 ± 3.5	NS (0.315)
LV _{syst} [mm]	35.2 ± 6	36.4 ± 6.9	32.4 ± 3	NS (0.086)
LVM [g]	233 ± 66	267 ± 89	210 ± 51	0.008*
LVMI [g/m ²]	121 ± 26	131 ± 27	114 ± 19	NS (0.203)
LVEF [%]	58.1 ± 6	56.1 ± 6.9	61.8 ± 3	0.003**

Abbreviations: LA_{ap} – antero-posterior dimension of the left atrium, LA_{vol} – left atrium volume, LV_{diast} – left ventricular diastolic dimension, LV_{syst} – left ventricular systolic dimension, LVM – left ventricular mass, LVMI – left ventricular mass index, VEF – left ventricular ejection fraction

* significant difference between the group of permanent AF and the remaining groups

** significant difference between the group of permanent AF and the control group

Table III. Natriuretic peptide release in response to exercise in patients with persistent or permanent AF, and control group

Parameter n = 77	Persistent AF n = 42	Permanent AF n = 20	Control group	p
ANP ₀ [pg/ml]	258 ± 89.7	208 ± 76.7	67 ± 21.2	< 0.0001*
ANP _{ex} [pg/ml]	324.3 ± 102.8	296 ± 113	117 ± 29.4	< 0.0001**
Δ ANP _{ex} [pg/ml]	84.6 ± 51	88.2 ± 55.7	50.1 ± 17.0	0.0092**
BNP ₀ [pg/ml]	82.3 ± 33	95.6 ± 46.4	37.5 ± 13	< 0.0001**
BNP _{ex} [pg/ml]	101 ± 52.9	119 ± 62	39.7 ± 13.4	< 0.0001**
Δ BNP _{ex} [pg/ml]	18.9 ± 27.6	23.4 ± 32.6	2.2 ± 1.6	0.0043**
RR ₀ [mmHg]	123 ± 15.9	131 ± 15	128.7 ± 14.7	< 0.05***
BP _{ex} [mmHg]	151 ± 17	142 ± 12	151 ± 9	0.0026****
Δ BP _{ex} [mmHg]	28.7 ± 20.2	10.8 ± 8.5	22.7 ± 11.5	< 0.0001****
Δ BP _{ex} / RR ₀	0.25 ± 0.18	0.09 ± 0.07	0.19 ± 0.12	< 0.0001****
HR ₀ [bpm]	77 ± 9.6	81 ± 8.1	71 ± 7	< 0.05**
HR _{ex} [bpm]	152 ± 13	139 ± 11.3	131 ± 13	< 0.0001*
Δ HR _{ex} [bpm]	75.2 ± 13.2	57.3 ± 13	60 ± 13	< 0.0001****
Δ HR _{ex} / HR ₀	0.86 ± 0.24	0.72 ± 0.22	0.86 ± 0.22	0.0071****

Abbreviations: ANP₀ – ANP concentration before exercise test, ANP_{ex} – ANP concentration immediately after exercise test, Δ ANP_{ex} – ANP concentration increase during exercise test, BNP₀ – BNP concentration before exercise test, BNP_{ex} – BNP concentration immediately after exercise test, Δ BNP_{ex} – BNP concentration increase during exercise test, BP₀ – systolic blood pressure before exercise test, BP_{ex} – systolic blood pressure at peak exercise, Δ BP_{ex} – increase in systolic blood pressure during exercise test, HR₀ – mean heart rate before exercise test, HR_{ex} – mean heart rate at peak exercise, Δ HR_{ex} – increase in heart rate during exercise test, bpm – beats per minute

* significant difference between the control group and the groups of persistent and permanent AF as well as between the group of persistent and permanent AF

** significant difference between the control group and the groups of persistent and permanent AF

*** significant difference between persistent and permanent AF groups

**** significant difference between the group of permanent AF and persistent AF group and the control group

***** significant difference between the group of persistent AF and permanent AF group and the control group

exertional absolute and relative increase of systolic blood pressure and heart rate was present in the group of permanent AF (Table III).

Discussion

In our study we measured levels of ANP and BNP on exertion in order to determine the ability of cardiac myocytes to increase secretion (secretion reserve) of these peptides in response to exercise. The highest relative

exertional increase of ANP levels and the smallest relative BNP increase were observed in the control group. Both exertional levels of ANP and BNP as well as relative and absolute increase of the peptide levels in patients with permanent and persistent AF did not differ significantly. It seems that these results may support the hypothesis that permanent and persistent AF are the same disease but in different stages of mechanical, electrical and humoral remodelling and in different stages of reversibility

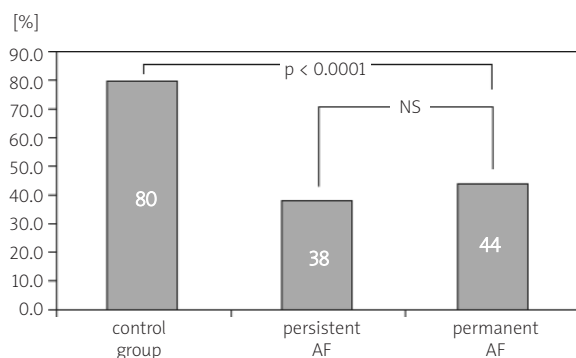


Figure 1. Relative increase (%) of ANP secretion in response to exercise in the studied groups as compared to baseline concentration

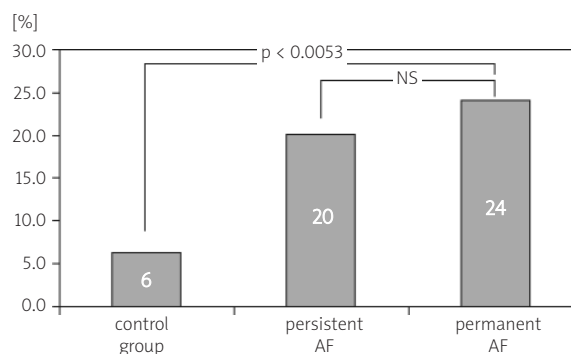


Figure 2. Relative increase (%) of BNP secretion in response to exercise in the studied groups as compared to baseline concentration

of the underlying mechanisms. Plasma levels of natriuretic peptides are influenced by several factors including body position. An effort was made to unify the conditions of blood sampling for all patients. Blood samples for baseline natriuretic peptides levels were obtained after 30 min rest (during this time an echocardiographic study was performed).

Exercise test is a reliable method of assessing not only haemodynamic and electrocardiographic but also neurohormonal response to exercise. Exercise tests in patients with AF were started in 1824 by Blumgart, and they have been routinely performed since 1968. Exercise tests in patients with AF differ from those performed in patients with sinus rhythm [5, 6]. In patients with AF inappropriate heart rate increase in the first minutes of the test is observed (much more pronounced than in individuals without arrhythmia). It is due to the influence of catecholamines and the sympathetic system on the atrioventricular node. The assessment of heart rate in patients with AF during the exercise test is difficult because of the high variability in RR intervals' duration. Heart rate depends not only on the duration of exercise and adaptation of the cardiovascular system. It can vary substantially in patients of the same age and in similar stage of the underlying disease. That is why in our study the protocol of the exercise test was limited by time with the same exertion period for all patients to provide unification of the methodology and to make the results as objective as possible. It should be underlined that the tolerance of the exercise by the studied patients was good and all patients performed the whole test (10 min).

Most published reports on the influence of exercise on natriuretic peptide secretion dealt with individuals with sinus rhythm, healthy people or patients with heart failure (HF). The results of these studies provided conflicting data. It is due to the high variability of the studied populations, non-uniform protocols and conditions of performing the study as well as concomitant medications (beta-blockers, diuretics, angiotensin-converting enzyme

inhibitors). Most studies reported a typical increase in ANP and BNP levels in response to exercise in persons with sinus rhythm. However, the available data provide conflicting results concerning the rapidness of this process, the degree of this increase and about the relation of the levels of both peptides. A significant rise in natriuretic peptide levels in response to exercise is reported for ANP, in contrast to more stable BNP levels [7, 8]. This can be explained by different mechanism of peptide release: rapid release of ANP from the granules of cardiac myocytes of the atria and slower synthesis of BNP in cardiac myocytes of the ventricles.

The physiological processes which compensate the raised exercise overload are increased venous return, sympathetic system activation and increase of blood pressure and heart rate, which leads to the elevation of pressure in the atrium. Exercise due to changes in blood distribution also causes a renal-dependent antinatriuretic effect [9]. In these conditions natriuresis, vasodilatation and haemo-concentration effects of ANP serve as important autoregulation mechanisms. Vasodilatation leads to a compensatory increase in cardiac output and blood perfusion of the working muscles and an increase in haematocrit, and haemoconcentration causes more rapid oxygen release. Friedl et al. demonstrated that elevation of ANP levels during exercise is inversely proportional to the severity of HF. Far less pronounced increases in BNP levels on exertion were similar and small in all groups regardless of NYHA class. These authors observed a correlation between peptide levels and parameters obtained during invasive measurements in exercise (for example with pulmonary capillary wedge pressure) [10]. Barletta et al. [11] showed that the mechanism of ANP release is based on atrial regulation and for BNP on ventricle regulation. In healthy volunteers there was an association between ANP levels and left atrial volume as well as E/A ratio of the mitral inflow. For BNP levels a relation between left ventricular dimension and ejection fraction was observed. McNairy et al. [12] observed

only mild increase in BNP levels in response to exercise in patients with HF. In the paper by Steele et al. [13] patients with HF had a significant increase in ANP levels in response to exertion, and moderate increase of BNP levels, in contrast to healthy volunteers, in whom concentrations remained almost unchanged. The lack of change in BNP levels during exercise was confirmed by others [14].

On the other hand, patients with impaired left ventricular function react with significant increase in BNP synthesis in response to exertion. Apart from left ventricular diastolic dysfunction, other mechanisms may be responsible for this reaction, such as left ventricular hypertrophy and atrial wall stretch [15]. It seems that in healthy individuals there are different mechanisms of BNP and ANP release during exercise and in patients with HF those mechanisms of peptide secretion from granules change and become partially common. Those similarities are also observed in patients with supraventricular tachyarrhythmias [16-18]. The BNP is an indicator of haemodynamic function of the heart and ANP is a marker of atrium overload and heart rate. It can be simplified that an increase in ANP on exertion may be described as a compensatory mechanism of the heart in normal conditions, whereas an increase in BNP levels serves as adaptation of the failing heart to increased overload. Similar conclusions were presented by Danish authors, who observed elevated secretion of BNP only in patients with HF. On the other hand, in healthy volunteers elevated levels of ANP were observed as a reaction to exercise [19]. These authors also reported an earlier peak of ANP release (punctum maximum) in patients with HF as compared to healthy individuals, which was explained by the deficit of the peptide molecules in granules of cardiac myocytes in patients with HF.

There are few data concerning exertional neurohormonal studies. Engelman et al. in a group of patients with permanent AF, who performed the exercise test, observed a relative increase of BNP levels in patients with AF, which was significantly higher than in patients from the control group [20]. The results of our study are close to those reported by Engelman et al. [20], although we observed a lower (in comparison to the data from the paper by Engelman et al.) increase of ANP levels when compared to controls. In patients with AF and with complete atrioventricular block and with an implanted pacemaker system exercise did not result in elevation of ANP levels [21].

In other studies a significant increase of ANP levels in response to exercise was a predictor of successful direct current cardioversion and the maintenance of sinus rhythm [22, 23]. It seems that the pattern of neurohormonal response to exercise in the case of ANP reflects not only the functional status but also morphological changes of the atria. Lack of adequate increase in ANP secretion is present in patients with more severe disease, affecting the atria, which is represented by degenerative processes,

atrophy, steatosis and fibrosis. These processes lead to a decrease of the amount of cardiac myocytes in the atria with normal function and structure.

The highest exertional increase in ANP levels was noted in our study in patients from the control group, whereas in patients with persistent and permanent AF a lower ANP increase was observed, which perhaps may reflect decreased reserve to secrete ANP as a consequence of long duration of the disease. We also noted a higher increase of BNP levels in patients with AF than in controls, which may reflect more severe injury of the heart in the studied population. The results of the current study provide evidence that there is a significant increase of natriuretic peptide concentrations in patients with AF in response to exercise. These changes probably reflect compensatory mechanisms, which enable the adaptation to exercise of patients with AF. It is known that increased BNP levels are associated, independently of age, with NYHA class and left ventricular dysfunction with higher probability of death and hospitalisation because of HF [24]. Further studies are needed to evaluate the prognostic implications of increased baseline natriuretic peptide levels and their extensive oversecretion during exercise in patients with AF.

Conclusions

Exercise testing may serve not only to assess haemodynamic and electrocardiographic response to exertion but also to determine the ability of cardiac myocytes to increase peptide secretion. Significant differences were observed between groups of patients with AF and controls in ANP and BNP level increase during exercise. The studied patients presented different patterns of neurohormonal response. Significant increase in ANP levels and stable concentrations of BNP levels were characteristic for the control group and this pattern of neurohormonal reaction may reflect better haemodynamic status and secretion ability as compared with individuals with arrhythmia.

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Wpływ wysiłku fizycznego na wydzielanie peptydów natriuretycznych u chorych z migotaniem przedsionków

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Streszczenie

Wstęp: Peptydy natriuretyczne są czułym wskaźnikiem stanu hemodynamicznego, natomiast mało zbadany jest wpływ wysiłku fizycznego u chorych z migotaniem przedsionków (ang. *atrial fibrillation*, AF) na wydzielanie przedsionkowego (ang. *atrial natriuretic peptide*, ANP) i mózgowego peptydu natriuretycznego (ang. *brain natriuretic peptide*, BNP). Ocena rezerwy wydzielniczej miocytów serca w czasie obciążenia wysiłkiem może stanowić istotny element procesu diagnostycznego i prognostycznego u chorych z AF.

Cel: Ocena wpływu obciążenia wysiłkiem fizycznym na wydzielanie peptydów natriuretycznych u chorych z AF.

Metody: Do badania włączano dorosłe osoby z przetrwałym AF, dobrze kontrolowaną częstotliwością rytmu komór i prawidłową funkcją skurczową lewej komory, u których zaplanowano podjęcie próby przywrócenia rytmu zatokowego za pomocą kardiowersji elektrycznej. Kryterium wyłączenia stanowiły: niedostateczna spoczynkowa kontrola częstotliwości rytmu AF ($\geq 90/\text{min}$), objawy niewydolności serca powyżej II klasy wg NYHA, znaczne powiększenie jam serca [lewy przedsionek (LP) > 60 mm, lewa komora (LK) $> 65/45$ mm], frakcja wyrzutowa LK $< 45\%$, niewydolność nerek, wątroby, ostre stany zapalne i ostra niewydolność wieńcowa. Badanie EKG obciążeniowe (test wysiłkowy) wykonywano w grupie przetrwałego, utrwalonego AF i w grupie kontrolnej u chorych ze znormalizowanym ciśnieniem tętniczym i zadowalającą kontrolą częstotliwości rytmu. Badanie przeprowadzono wg zmodyfikowanego protokołu Bruce'a, na bieżni ruchomej, w ciągu 10 min lub do wystąpienia kryteriów zakończenia badania. Krew pobierano przed wysiłkiem i bezpośrednio po zaprzestaniu wysiłku i oznaczano stężenie peptydów natriuretycznych metodą radioimmunologiczną (RIA Peninsula Lab.Inc.).

Wyniki: Próbie poddano 77 chorych z przetrwałym i 42 z utrwalonym AF oraz 20 osób w grupie kontrolnej. Czas trwania testu wynosił 10 min przy koszcie energetycznym średnio $6,1 \pm 0,4$ MET. Wszyscy chorzy ukończyli próbę. Obserwowano zwiększenie wydzielania peptydów natriuretycznych w odpowiedzi na stymulację wysiłkiem fizycznym. Stopień wzrostu sekrecji peptydów natriuretycznych był zróżnicowany w zależności od badanej grupy i rodzaju peptydu. Najwyższy względny przyrost powysiłkowego poziomu ANP i najniższy BNP stwierdzano w grupie kontrolnej. Zarówno poziom wysiłkowego stężenia ANP i BNP, jak i względne i bezwzględne przyrosty stężenia peptydów w grupach przetrwałego i utrwalonego AF nie różniły się istotnie między sobą.

Wnioski: Test wysiłkowy może służyć nie tylko ocenie hemodynamicznej i elektrokardiograficznej, ale także do określenia rezerwy wydzielniczej kardiomiocytów. Istotny wzrost stężenia ANP i stabilność stężeń BNP cechowały grupę kontrolną. Reakcja taka może wynikać z korzystniejszej sytuacji hemodynamicznej i wydzielniczej tej grupy w porównaniu z chorymi z AF.

Słowa kluczowe: peptydy natriuretyczne, test wysiłkowy, migotanie przedsionków

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