Original article

Determinants of physical fitness in males with systolic heart failure

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Abstract

Background: Heart failure (HF) is a systemic disease which affects mainly older adults. The main symptom of HF is exercise intolerance which in the course of disease can cause limitations in independent functioning. So far no study on the impact of HF on physical fitness in men, regardless of disease severity, has been reported.

Aim: To evaluate physical fitness in men with HF independently of age, HF severity, concomitant diseases and pharmacological treatment.

Methods: The study group consisted of 228 men with stable systolic dysfunction (age 60 ± 11, left ventricular ejection fraction – LVEF 29 ± 9%, NYHA class I/II/III/IV – 17/44/35/4%). In order to assess physical fitness the Functional Fitness Test by Rikli & Jones for older adults was used.

Results: The level of physical fitness decreased with age. Patients with greater severity of HF had worse aerobic endurance, agility and muscular endurance in comparison with men in NYHA classes I-II. A lower level of agility and dynamic balance was found in patients with higher concentration of NT-proBNP and lower levels of haemoglobin and eGFR. Coexisting atrial fibrillation and diabetes mellitus were associated with decreased physical fitness. No relationship between flexibility and clinical parameters or concomitant diseases was found in the study group.

Conclusions: The most important determinants of physical fitness in men with HF were age and NYHA class. Additional factors which decreased physical fitness were atrial fibrillation and diabetes mellitus. Higher level of NT-proBNP and lower levels of haemoglobin were associated with a reduction of upper body strength and aerobic endurance.

Key words: heart failure, physical fitness, severity of disease

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Introduction

In the course of aging degenerative changes occur in the musculoskeletal system. A coexisting chronic disease is an additional factor accelerating the reduction in physical capacity and activity, and as a consequence contributing to the limitation of independent functioning and therefore to disability [1-4].

Heart failure (HF) is a systemic disease which affects mostly elderly people with other comorbidities [2, 5, 6]. According to the muscular hypothesis, impairment of musculoskeletal structure and function secondary to HF contributes to the development of exercise intolerance, e.g. dyspnoea or fatigue [7].

Additionally, diseases coexisting with HF such as diabetes, renal failure, anaemia or atrial fibrillation worsen physical fitness and clinical condition [8-10].

Spiroergometry and 6-minute walk test are the most commonly used methods in functional assessment of patients with HF [11-14]. However, no other mobility capacities (agility, endurance, flexibility, balance), which are mostly determined by musculoskeletal efficacy, are routinely assessed in this group. Musculoskeletal changes secondary to HF may be the cause of the reduction of motor capacity level in these patients. Also, there are no published data on the relationship between selected components of physical fitness and the degree of severity of HF and coexisting diseases.

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The aim of this study was to assess the physical fitness in men with systolic HF with regards to their age, severity of HF, comorbidities and pharmacological therapy administered.

Methods

The study protocol was accepted by the Senate Committee on Ethics in Scientific Research at the University School of Physical Education in Wroclaw.

Study population

The 228 men admitted to the Cardiology Department or treated in the Heart Failure Clinic were included in the study. The inclusion criteria were:

1. age between 30 and 80 years,
2. heart failure with functional NYHA classes I-IV diagnosed at least 3 months earlier,
3. left ventricular ejection fraction < 45%,
4. pharmacological therapy maintained without modifications for the previous month.

Exclusion criteria were:

1. acute coronary syndrome or decompensated heart failure within the last 3 months,
2. revascularisation procedure within the last 6 months (coronary angioplasty, coronary artery bypass graft operation),
3. renal failure requiring dialysis,
4. lack of patient's consent to participate in the study.

Patient characteristics in the study group are presented in Table I.

Physical fitness test

To assess physical fitness in patients with HF the Functional Fitness Test for older adults by Rikli and Jones was used [15, 16]. All studies (except the 6-minute walk test) were carried out in the functional testing department where resuscitation trolleys were available. According to the safety rules of cardiac rehabilitation, before and after the test the tasks with a cardiovascular burden blood pressure and heart rate were measured. An investigator described in detail all tasks to each patient and demonstrated subsequent physical activities before the test.

The Functional Fitness Test involved 6 physical tasks:

1. Up and go – to assess agility and dynamic balance.
   In this test patients were asked to stand up from a chair as fast as possible, walk around a pole placed within 2.44 m and return to the baseline position. An investigator measured the time of the test with an accuracy of 0.1 s.
2. Chair stand – to assess lower body strength.
   In this test patients were asked to do as many full stands from a chair as possible within 30 s with their arms folded across the chest. The number of completed full stands was the result of the test.
3. Arm curl – to assess upper body strength.
   In this test a patient was asked to do as many 3.5 kg weight lifts with their forearm within 30 s if possible. At baseline the patient was sitting on a chair with a weight in the dominant forearm in an intermediate position. The patient was asked to lift the weight by flexion and pronation of the forearm and return to the baseline position. The number of completed full lifts was the result of the test.
4. Chair sit-and-reach – to assess lower body flexibility.
   The patient was asked to reach with the hands toward the toes from a sitting position at the front of a chair with the dominant leg extended and the foot in dorsiflexion resting on the floor. The distance between the extended fingers and the tip of the toes was measured with an accuracy of 0.5 cm.
5. Back scratch – to assess upper body flexibility.
   The patient was asked to reach with one hand over the shoulder towards the other hand up in the middle of the back. The distance between extended fingers of both hands was measured with an accuracy of 0.5 cm.
6. Six-minute walk (6MW) – to assess aerobic endurance.
   This test was carried out in the specially reserved 30-metre long part of the hospital corridor. The patient was asked to walk back and forth along the corridor as fast

Table I. Clinical characteristics of the study group of 228 men with systolic HF

Variables	
Age [years]	60 ± 11
BMI [kg/m^2]	27.7 ± 4.6
HF aetiology (ischaemic)	149 (65.4%)
NYHA class (I/II/III/IV)	38/100/81/9 (17%/44%/35%/4%)
LVEF [%]	29 ± 9
NT-proBNP plasma levels [pg/ml]	1436 (409-4278)
Haemoglobin levels [g/dl]	14.1 ± 1.6
eGFR [ml/min/1.73 m^2]	72.3 ± 19.2
Comorbidities, n (%)	
• diabetes	66 (29)
• hypertension	104 (46)
• atrial fibrillation	82 (36)
Pharmacological treatment, n (%)	
• ACE inhibitor or ARB	215 (94)
• beta-blocker	204 (89)
• digoxin	75 (33)
• statin	158 (69)
• diuretics	190 (83)
• aspirin	121 (53)

Abbreviations: BMI – body mass index, NYHA – New York Heart Association, LVEF – left ventricular ejection fraction, NT-proBNP – N-terminal prohormone of B-type natriuretic peptide type B, eGFR – glomerular filtration rate, ACE inhibitor – angiotensin-converting enzyme inhibitor, ARB – angiotensin receptor blocker

Table II. Relationship between physical fitness, age and clinical parameters (univariable correlation analysis) – values of correlation coefficients are presented

Physical fitness	Age			LVEF			NT-proBNP			Haemoglobin			eGFR		
	NYHA I-IV (n = 228)	NYHA I-II (n = 138)	NYHA III-IV (n = 90)	NYHA I-IV	NYHA I-II	NYHA III-IV	NYHA I-IV	NYHA I-II	NYHA III-IV	NYHA I-IV	NYHA I-II	NYHA III-IV	NYHA I-IV	NYHA I-II	NYHA III-IV
6MW test [m]	−0.37****	−0.43****	−0.01	0.16*	0.21*	0.01	−0.29****	−0.19*	−0.22**	0.33****	0.20*	0.12	0.28****	0.21**	−0.01
Up-and-go [s]	0.32****	0.41****	0.11	0.04	-0.01	0.17	0.13**	0.03	-0.06	−0.30****	−0.22**	−0.13	−0.17**	−0.18**	0.08
Chair stand [number of stands]	−0.29****	−0.27**	−0.02	0.07	0.11	−0.05	−0.30****	−0.11	−0.19**	0.35****	0.15*	0.23*	0.21**	0.04	0.01
Arm curl [number of lifts]	−0.35****	−0.43****	0.02	0.08	0.10	−0.01	−0.33****	−0.22*	−0.31**	0.36****	0.26**	0.21*	0.18**	0.07	−0.01
Chair sit-and-reach [cm]	−0.17*	−0.08	−0.19	−0.12	−0.13	−0.14	−0.03	−0.01	0.02	0.03	−0.11	0.05	0.02	−0.03	−0.04
Back scratch [cm]	−0.18**	−0.3	−0.02	−0.05	0.06	−0.19	0.03	−0.01	−0.09	0.10	0.,13	0.04	0.04	0.11	−0.11

Abbreviations: LVEF – left ventricular ejection fraction, eGFR – glomerular filtration rate
** p < 0.05, ** p < 0.01, *** p < 0.001, **** p < 0.0001*

as possible so as to walk the longest distance possible within 6 minutes. The number of metres that could be walked in 6 minutes was measured with an accuracy of 1 m.

Other tests

In all patients medical history was taken, physical examination was performed and laboratory tests were obtained (levels of N-terminal prohormone of B-type natriuretic peptide – NT-proBNP, haemoglobin, creatinine). Serum levels of NT-pro-BNP were measured using immunoassay (Elecsys, Roche).

Estimated glomerular filtration rate (eGFR) was calculated on the basis of the modified MDRD formula:

$$\text{eGFR} = 186 \times [\text{serum creatinine levels}]^{-1.154} \times [\text{age}]^{-0.203}$$

Left ventricular ejection fraction (LVEF) was assessed by planimetric Simpson's method in an echocardiographic study.

Statistical analysis

The results are presented as means with standard deviations (means ± SD) and frequencies for selected parameters. The differences between groups were analysed with Student's t-test for independent samples. The results of physical fitness tests according to patients' age were analysed by linear regression. The relationship between physical fitness parameters and clinical data was assessed by means of univariable linear regression to obtain correlation coefficients and with multivariable regression. A p value < 0.05 was considered significant.

Results

The physical fitness test was carried out in all 228 studied patients. To assess the relationship between physical fitness and age or clinical parameters in men with HF univariable and multivariable analyses were performed (Table II).

In the study group physical fitness depended on patients' age. There were strong univariable correlations between age of men in NYHA classes I-II and worsening of aerobic endurance, agility and strength endurance. However, in men in NYHA classes III-IV physical fitness did not depend on age. As shown in Figure 1, in the group of patients with NYHA classes I-II walking distance in 6MW decreased with age, whereas in men with NYHA classes III-IV the level of physical fitness was independent of age. Similarly, strength, agility and dynamic balance depended on age in NYHA classes I-II.

To assess the level of physical fitness in men of varied NYHA classes according to the severity of HF the relationships between certain mobility variables and LVEF or NT-proBNP levels were analysed. The study group was

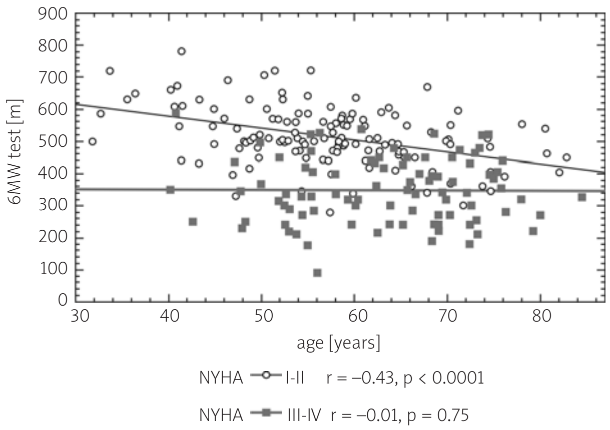

Figure 1. 6MW test results in relation to age and disease severity

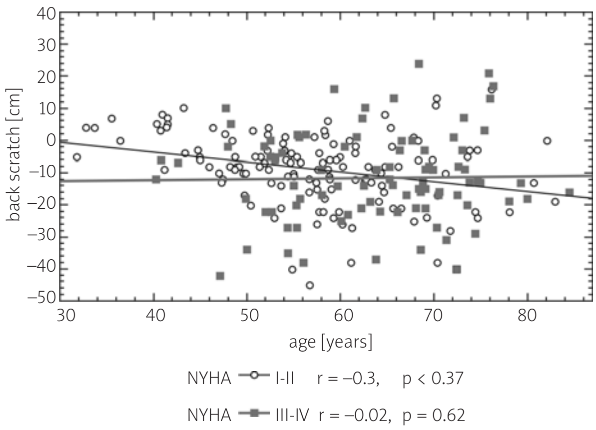

Figure 2. Back scratch test results in relation to age and disease severity

divided into two subgroups: NYHA I-II and NYHA III-IV. Men with more advanced HF (NYHA III-IV) had decreased physical fitness with regards to aerobic endurance, agility and dynamic balance as well as muscular endurance as compared with patients in NYHA classes III-IV (Table III). Also, in patients with NYHA classes III-IV the subjective dyspnoea and fatigue on a modified 0-10 Borg scale were higher than in patients with NYHA classes I-II (dyspnoea 5.4 ± 3.2 vs. 2.3 ± 2.9, p < 0.0001; fatigue 7.2 ± 1.8 vs. 6.2 ± 2.1, p < 0.001).

In univariable analysis there was a weak correlation between aerobic endurance assessed by 6MW and LVEF. Walking distance decreased with more impaired LVEF in patients with NYHA classes I-II, while in more advanced HF the walking distance did not depend on LVEF. There was no relationship between other components of physical fitness and LVEF for either NYHA group. There was a correlation between NT-proBNP levels and the results of fitness tests (apart from the flexibility tests). The NT-proBNP levels increased with a decrease in aerobic endurance and strength endurance in both mild and advanced HF. Aerobic endurance depended on the aetiology of HF. Patients with ischaemic HF had shorter walking distance in 6MW as compared with patients with non-ischaemic HF (427 ± 122 vs. 486 ± 125, p < 0.0001).

The relationship between physical fitness and coexisting conditions was analysed in a univariable model. Decreased levels of haemoglobin were associated with a significant decline of physical fitness in NYHA groups I-II. Meanwhile, in men in NYHA classes III to IV, lower levels of haemoglobin were associated with worse strength endurance. It was also noted that in patients with NYHA class I or II worse results of aerobic endurance and agility were associated with lower eGFR values. There was no such a correlation in patients with more advanced HF.

Atrial fibrillation and diabetes reduced aerobic endurance, agility and muscular endurance in men with intermediate or severe HF (NYHA III-IV) (Table IV). Hypertension had no impact on physical fitness.

Flexibility assessed in chair sit-and-reach and back scratch tests did not correlate with any clinical parameter or comorbidity in either group of subjects.

Studied patients with HF were treated according to the recommendations of the European Society of Cardiology (Table I). Patients receiving diuretics had worse parameters of physical fitness with regards to strength and aerobic endurance (6MW: 435 ± 130 vs. 518 ± 122; chair stand: 12.7 ± 4.0 vs. 14.9 ± 3.9; arm curl: 13.2 ± 4.2 vs. 15.8 ± 4.7, p < 0.05) as compared with other patients. There was no significant difference with regards to other medications.

Table III. Physical fitness test results

Physical fitness test	NYHA I-IV n = 228	NYHA I-II n = 138	NYHA III-IV n = 90	NYHA I-II vs. III-IV t	 p
6MW test [m]	447 ± 126 (90-780)	513 ± 93	347 ± 101	–12.7	0.0001
Up-and-go [s]	6.1 ± 1.9 (3.1-16.1)	5.3 ± 1.0	7.3 ± 2.3	9.2	0.0001
Chair stand [number of stands]	13.0 ± 4.1 (3-24)	15.0 ± 3.0	10.0 ± 3.6	–11.1	0.0001
Arm curl [number of lifts]	13.6 ± 4.4 (2-26)	15.4 ± 3.8	10.9 ± 3.8	–8.6	0.0001
Chair sit-and-reach [cm]	–1.3 ± 10.4 (–26-30)	0.0 ± 10	–3.2 ± 10.8	–2.3	0.02
Back scratch [cm]	–9.9 ± 12.4 (–49-21)	–8.8 ± 10.9	–11.6 ± 14.3	–1.7	0.09

Table IV. Physical fitness in relation to coexisting conditions

Comorbidities	Physical fitness tests	NYHA I-IV		NYHA I-II		NYHA III-IV		NYHA		
		n = 146	n = 82	n = 100	n = 38	n = 46	n = 44	I-IV	I-II	III-IV
		without AF	with AF	without AF	with AF	without AF	with AF	p	p without AF vs. with AF	p
Atrial fibrillation	6MW test [m]	467 ± 119	412 ± 132	516 ± 93	505 ± 92	371 ± 95	322 ± 106	0.001	0.51	0.05
	Up-and-go [s]	5.7 ± 1.3	6.7 ± 2.5	5.3 ± 1.0	5.2 ± 0.9	6.7 ± 1.5	7.9 ± 2.8	0.0004	0.76	0.01
	Chair stand [number of stands]	13.7 ± 3.6	11.9 ± 4.6	15.0 ± 3.1	14.9 ± 2.9	10.9 ± 2.9	9.1 ± 4.2	0.001	0.84	0.05
	Arm curl [number of lifts]	14.2 ± 4.1	12.5 ± 4.7	15.3 ± 3.7	15.4 ± 3.6	11.8 ± 3.4	10.0 ± 4.1	0.004	0.94	0.03
	Chair sit-and-reach [cm]	–1.1 ± 10.3	–1.5 ± 10.6	–0.2 ± 10.1	0.5 ± 9.9	–3.1 ± 10.7	–3.3 ± 11.0	0.78	0.72	0.95
	Back scratch [cm]	–9.3 ± 11.9	–11.1 ± 13.4	–8.9 ± 10.7	–8.8 ± 11.7	–10.1 ± 14.2	–13.6 ± 14.5	0.75	0.96	0.31
		without DM	with DM	without DM	with DM	without DM	with DM		without DM vs. with DM	.
Diabetes	6MW test [m]	465 ± 125	404 ± 119	515 ± 96	503 ± 82	366 ± 110	324 ± 87	0.0007	0.56	0.06
	Up-and-go [s]	5.8 ± 1.7	6.8 ± 2.2	5.2 ± 0.9	5.4 ± 0.9	7.0 ± 2.1	7.7 ± 2.4	0.0004	0.60	0.03
	Chair stand [number of stands]	13.5 ± 3.9	11.8 ± 4.3	14.9 ± 3.1	15.2 ± 3.0	10.5 ± 3.8	9.5 ± 3.4	0.003	0.76	0.05
	Arm curl [number of lifts]	14.0 ± 4.3	12.5 ± 4.3	15.4 ± 3.8	15.2 ± 3.8	11.1 ± 3.9	10.7 ± 3.7	0.01	0.80	0.59
	Chair sit-and-reach [cm]	–0.6 ± 10.4	–2.9 ± 10.3	0.13 ± 9.9	–0.6 ± 10.5	–2.2 ± 11.3	–4.5 ± 10.0	0.13	0.73	0.31
	Back scratch [cm]	–9.1 ± 11.7	–12.0 ± 13.9	–8.8 ± 10.6	–8.8 ± 12.3	–9.6 ± 13.8	–14.3 ± 14.8	0.11	0.97	0.07

Table V. Relationship between physical fitness, age and clinical parameters (multivariable correlation analysis)

Physical fitness test	Age [years]	NYHA	NT-proBNP [pg/ml]	eGFR [ml/min/1.73 m²]	Haemoglobin [g/dl]	BMI [kg/m²]	Aetiology	AF [T/N]	DM [T/N]	Diuretics [T/N]	ACE inhibitors [T/N]
6MW test [m]	F = 4.36*	F = 39.72****	F = 6.62**	–	–	–	F = 3.87*	–	–	–	–
	F = 20.48****	–	F = 19.50****	–	–	–	–	F = 4.05*	F = 8.83**	–	–
Up-and-go [s]	F = 17.10****	F = 42.11****	–	F = 4.26*	–	–	–	–	F = 5.67**	–	–
	F = 21.70****	–	–	F = 0.14, p = 0.71	–	–	–	F = 13.22****	–	–	–
Chair stands [number of stands]	F = 6.06*	F = 21.93****	–	–	–	–	–	–	–	–	F = 3.67*
	F = 20.79 ****	–	–	–	–	–	–	–	–	F = 9.54**	–
Arm curls [number of lifts]	F = 15.79****	F = 26.09****	F = 11.59****	F = 8.17***	F = 3.02, p = 0.08	–	–	–	–	–	–
	F = 17.65 ****	–	F = 13.07 ****	F = 0.95, p = 0.33	F = 10.86 ****	–	–	–	–	F = 5.88 *	–
Chair sit-and-reach [cm]	r = 3.73, p = 0055	–	–	–	–	–	–	–	–	–	–
Back scratch [cm]	β = –0.18 **	–	–	–	–	β = –0.19 **	–	–	–	–	–

*Abbreviations: F – multivariable regression analysis test value, β – standardised regression coefficient, AF – atrial fibrillation, DM – diabetes, * p < 0.05, ** p < 0.01, *** p < 0.001, **** p < 0.0001*

Continuous and categorical variables were included in the multivariable analysis (Table V). Since the possibility to include all variables in one model was limited, data were entered arbitrarily into two separate models. In the case of flexibility tests (chair sit-and-reach and back scratch) only one model is presented, as there were no other significant correlations. Multivariable analysis revealed age as an independent predictor of all physical fitness components in men with HF. What is more, a relation was noted between decreased aerobic endurance and NYHA class, increased NT-proBNP levels, atrial fibrillation, diabetes and ischaemic aetiology of HF. In multivariable models agility correlated inversely with age and was also associated with NYHA class, eGFR values, diabetes and atrial fibrillation. Decreased lower body muscular endurance was related to disease severity, age and treatment with diuretics and ACE inhibitors. The following determinants of decreased upper body muscular endurance were found in the multivariable model: age, NYHA class, increased eGFR values, increased NT-proBNP levels, decreased haemoglobin levels and use of diuretics.

Discussion

Patients with HF are in the majority elderly and they lead a so-called sedentary lifestyle; therefore it seems justified to suspect that these patients are especially at risk of impaired physical fitness and loss of independence [2, 6]. On account of decreased exercise tolerance and advanced age of patients with HF, the Functional Fitness Test, also known as the Fullerton test, for older adults by Rikli and Jones was applied [15, 16]. Use of the test described by Rikli and Jones allowed the first assessment of all components of physical fitness in the population of men with HF. Our study provided a detailed analysis of physical fitness in men with stable systolic HF in relation to age, disease severity, coexisting conditions and pharmacological treatment.

It has been shown in the healthy population that older adults achieve worse results with regards to aerobic endurance, maximal strength and muscular endurance in comparison to younger subjects [10-20]. So far there have been no data published on the relation between age and physical fitness in men with HF. In the present study the multivariable model revealed age as an independent determinant of physical fitness. In univariable analysis physical fitness correlated with age in men with mild HF whereas there was no such a correlation in patients with HF in NYHA classes III-IV, in whom aerobic endurance, agility, and lower and upper body muscular endurance were independent of age.

In our previous studies we found that men with HF in NYHA classes I-II had worse fitness test results in comparison to reference values for age groups of healthy males [21]. This may be explained by abnormalities within the skeletal muscles, lack of physical activity, and symptoms of depression, which all together negatively influence physical fitness of patients with HF.

In multivariable models NYHA class was an independent determinant of aerobic endurance, agility and muscular endurance in men with HF. The level of these motor capacities decreased in patients with more advanced HF.

The 6MW test is a well known, commonly used and recommended tool in the assessment of physical endurance in patients with HF. It constitutes one of the six trials in the Fullerton test. Our observations are in concordance with previously published studies, in which patients with severe HF (NYHA III-IV) had a significantly shorter walking distance in comparison to patients with a mild degree of disease (NYHA II) [12, 22, 23]. It has not been reported yet whether NYHA class correlates with muscular endurance, agility or dynamic balance. It has thus been shown that maximal lower and upper body strength decreased in patients with more advanced HF classified by NYHA [24].

This study demonstrated that NT-proBNP level is an independent determinant of physical endurance assessed by 6MW and of upper body muscular endurance in patients with HF. The results of other studies confirmed that high levels of NT-proBNP are associated with impaired exercise tolerance assessed in spiroergometry [25, 26]. However, there are no published data on the relationship between NT-proBNP and other components of physical fitness in patients with HF. Only an increase in aerobic endurance and muscular strength as well as a decrease of NT-proBNP levels were found to correlate with an improvement in clinical condition assessed by NYHA classification in the studies assessing the effects of physical training in patients with intermediate or severe HF [27-29].

In contrast, there are conflicting data regarding body flexibility in mild and severe HF. Patients' age and BMI are independent determinants of upper body flexibility. Flexibility is related to the range of motion of a certain joint. It is a morphological feature which is genetically determined to a greater degree than other motor features (e.g. strength). The degree of flexibility, that is the range of joint motion, depends among other things on the shape of the joint surface, bone edges, soft tissue flexibility and muscle tension [30, 31]. It seems that all mentioned determinants of flexibility (apart from the physical activity limitations) remain unchanged in the course of HF, which can be confirmed by the results of this study, where no difference in flexibility was found across studied subgroups.

The relationship between LVEF and physical fitness in patients with HF have not been studied previously. In our study the univariable analysis showed only one a weak association between LVEF and walking distance in 6MW. However, in multivariable models no such correlation was found, in concordance with other studies [23]. Nor was there any correlation between LVEF and other motor capacities.

Coexisting conditions, such as diabetes, atrial fibrillation, renal function and anaemia, leading to an exacerbation of

HF and increasing the risk of death in this patient group were analysed by others [8-10]. In the present study the multivariable model showed that coexistence of diabetes and atrial fibrillation is associated with a decrease in aerobic endurance and agility while upper body muscular endurance depends on the haemoglobin levels and eGFR values. In previous studies it has already been demonstrated that patients with HF and coexisting anaemia, diabetes and atrial fibrillation had worse physical endurance (decreased maximal oxygen consumption, shorter walking distance in 6MW) [32-36]. The relationship between maximal oxygen consumption and other components of physical fitness has not been reported previously.

Men with HF included in our study were treated according to the recommendations of the European Society of Cardiology [5]. Our results showed that patients receiving diuretics have decreased physical fitness as compared to patients not requiring these drugs. This observation may be due to the fact that patients treated with diuretics were at a more advanced stage of HF. Multivariable analysis showed that taking diuretics is associated with decreased strength endurance. Diuretics induce a drop in plasma volume as well as an increase in peripheral resistance and blood pressure. They can cause hypokalaemia and, as a consequence, muscular fatigue; therefore they can contribute to skeletal muscle functional impairment.

Treatment with ACE inhibitors and/or ARB was associated with higher lower body muscular endurance. This observation is in concordance with previously published data which confirm the beneficial influence of ACE inhibitors on skeletal muscle function [37-40]. Vasodilating agents and ACE inhibitors may increase physical fitness in patients with HF because they decrease blood pressure at rest and during exercise by lowering angiotensin II and aldosterone levels in the blood. Also calcium blockers may delay ischaemia during exercise and improve exercise tolerance.

Study limitations

This study was carried out on a group of men exclusively and does not reflect characteristics of the whole population of patients with HF, which is a limitation of this project. There are no data regarding the length of disease history and its relation to the physical fitness level.

Conclusions

Age and disease severity assessed by NYHA classification are the strongest determinants of physical fitness in men with HF.

Coexistence of diabetes and atrial fibrillation additionally impairs aerobic endurance, agility and dynamic balance in patients with HF, whereas use of diuretics decreases muscular endurance.

Higher levels of NT-proBNP are associated with altered aerobic endurance and upper body muscular endurance, which is also impaired by decreased haemoglobin levels and abnormal renal function.

The Functional Fitness Test for older adults by Rikli and Jones, which was used in this study, could become a supplemental component of complex diagnosis in HF.

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Czynniki determinujące sprawność fizyczną mężczyzn ze skurczową niewydolnością serca

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Streszczenie

Wstęp: Niewydolność serca (HF) jest chorobą ogólnoustrojową, która dotyczy przede wszystkim osób starszych. Podstawowym objawem HF jest nietolerancja wysiłku fizycznego, która w zaawansowanym stadium choroby może prowadzić do ograniczenia niezależnego funkcjonowania. W tej grupie chorych nie oceniano zdolności motorycznych (szybkości, wytrzymałości siłowej, gibkości, równowagi), które w większości warunkowane są przez sprawną czynność mięśni szkieletowych. Dotychczas nie badano sprawności fizycznej osób z HF i jej związku z zaawansowaniem choroby.

Cel: Ocena sprawności fizycznej mężczyzn ze skurczową HF w zależności od wieku, stopnia zaawansowania HF, chorób współistniejących oraz stosowanego leczenia farmakologicznego.

Metody: Badaniem objęto 228 mężczyzn ze skurczową, stabilną HF (wiek 60 ± 11 lat, frakcja wyrzutowa lewej komory 29 ± 9%, I, II, III, IV klasa wg NYHA odpowiednio 17, 44, 35, 4%). Sprawność fizyczną oceniano za pomocą testu sprawności fizycznej dla osób starszych *Functional Fitness Test Rikli & Jones.*

Wyniki: Sprawność fizyczna mężczyzn z HF maleje wraz z wiekiem. Chorzy z bardziej zaawansowaną HF (w III i IV klasie wg NYHA) charakteryzują się gorszą wydolnością tlenową, zwinnością i dynamiczną równowagą oraz wytrzymałością siłową w porównaniu z chorymi w I i II klasie wg NYHA. Wykazano niższy poziom zdolności motorycznych u chorych z wyższym stężeniem NT-proBNP, świadczącym o bardziej zaawansowanej HF. Gorsza zwinność i wytrzymałość siłowa górnej części ciała wiąże się z niższym stężeniem hemoglobiny i współczynnikiem przesączania kłębuszkowego (eGFR). Współistnienie migotania przedsionków oraz cukrzycy u chorych z HF powoduje obniżenie wydolności tlenowej oraz zwinności i dynamicznej równowagi. Występowanie nadciśnienia tętniczego nie różnicowało poziomu sprawności fizycznej mężczyzn z HF. Nie wykazano związków gibkości z parametrami klinicznymi oraz schorzeniami towarzyszącymi w żadnej grupie mężczyzn z HF. Pacjenci przyjmujący diuretyki charakteryzowali się gorszą wytrzymałością siłową w porównaniu z chorymi niewymagającymi leczenia moczopędnego.

Wnioski: Najsilniejszymi, niezależnymi czynnikami determinującymi sprawność fizyczną mężczyzn z HF były wiek oraz klasa wg NYHA. Dodatkowym czynnikiem upośledzającym szybkość i wydolność tlenową było współistnienie migotania przedsionków i cukrzycy. Wyższe stężenie NT-proBNP wiązało się z gorszą wydolnością tlenową i wytrzymałością siłową górnej części ciała, którą ponadto upośledzały niższe stężenie hemoglobiny oraz zaburzona funkcja nerek.

Słowa kluczowe: niewydolność serca, sprawność fizyczna, ciężkość choroby

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