ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Nordic Walking could improve outcomes of the non-ST-segment elevation myocardial infarction

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Abstract

Background - More than half of cases of Acute Coronary Syndrome (ACS) are unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI). International guidelines for cardiac rehabilitation recommend to use aerobic and resistance exercises for patients with ACS.

Hypothesis - We suppose that Nordic Walking could be an effective method for those patients as well. The goal of our study is to evaluate the efficacy of Nordic walking rehab program.

Methods - Sixty-nine patients with NSTEMI after Percutaneous Coronary Intervention (PCI) (mean age=57.9±9.7 years) were recruited for this prospective study. The cohort was divided into two groups: the Cardiac rehab group (CRG) and the Nordic Walking group (NWG). At the 1st an 12th weeks patients were undergone a cardiac stress test and echocardiography. Data management and analysis were performed using SPSS 20.0.

Results - The most profound changes were observed in MET values (from 4.0±1.0 MET to 5.3±2.0 MET; p<0,001) and systolic volume, ejection fraction and total test time in cardiac stress test of the NWG (from 5.2±1.8 minutes to 7.3±2.0 minutes; p<0.001). At the same time in the CRG there were improvements in systolic volume, ejection fraction and total test time in cardiac stress test.

Conclusions - Nordic Walking could be an effective form of the cardiac rehabilitation program in patients with non-St-segment elevation myocardial infarction in comparison with other aerobic exercises. Patients may have an additional benefits from Nordic Walking comparing with ordinary walking and aerobic and resistance exercises. We suggest that Nordic Walking could be included in the international guidelines for cardiac rehabilitation.

Keywords- Cardiac rehabilitation, acute coronary syndrome, functional diagnostics, echocardiography, treadmill test, myocardial infarction.

Abbreviation
NW - Nordic Walking
ACS- Acute Coronary Syndrome
NSTEMI - non-ST-segment elevation myocardial infarction
CHD - coronary heart disease
BMI - body mass index
CRG - Cardiac rehabilitation group
NWG - Nordic Walking group

1 Introduction

Acute Coronary Syndrome (ACS) is the most common cause for emergency hospitalization worldwide [1]. More than half of cases are unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI) [2]. The annual incidence of ACS in the US is about 1.1 million cases per year [3]. The rate of incidence varies from country to country. Hospital mortality in patients with ST-segment elevation myocardial infarction (STEMI) is higher than in patients with NSTEMI [4]. However, this factor in patients with NSTEMI becomes 2 times higher than in patients with STEMI after 6th months [5].

Percutaneous Coronary Intervention (PCI) is rapidly becoming a key instrument in the revascularization of patients with coronary heart disease (CHD). However, there is a growing amount of literature that recognizes the importance of in-patient and out-patient programs for patients with NSTEMI. A positive prognosis depends not only on surgical and non-surgical treatment but also on cardiac rehabilitation programs, which should include long-term exercise training [6, 7].

Cardiac rehabilitation programs include aerobic and resistance exercises [8]. Aerobic exercises improve physical capacity and personal fitness both in healthy persons and in patients after ACS [9]. It has been demonstrated that aerobic exercise in cardiac patients has a number of benefits, e.g. reducing blood pressure and improving LDL levels, triacylglycerol levels and visceral and subcutaneous fat deposits[10].Long-term exercise training plays an important role in the secondary prevention of CVD. It reduces blood pressure (BP), body mass index (BMI), and blood lipids, and also increases exercise tolerance [11].Nordic Walking is a simple and attractive form of a physical activity that could be performed by everyone everywhere [12]. This type of brisk walk with special poles activates the upper body and arm muscles [13]. It also has been shown that upper limb aerobic training could improves fitness and working capacity [14].Co-morbid conditions are frequent among elderly patients with cardiovascular disease [15]. Nevertheless, the efficacy of NW was shown in conditions such as: diabetes mellitus type 2 [16], chronic obstructive pulmonary disease [17], lower back pain [18], obesity [19], and depression [20].

The main stage of physical rehabilitation is the out-patient stage, where patients receive special therapeutic exercises under the supervision of a sports medicine and rehabilitation physician or physiotherapist.

The aim of this study was to evaluate the efficacy of the out-patient rehabilitation program with Nordic Walking in patients with non-ST-segment elevation myocardial infarction by echocardiography and treadmill stress tests in comparison with common cardiac rehabilitation programs.

2 Materials And Methods

Sixty-nine patients with NSTEMI after PCI (mean age=57.9±9.7 years) were recruited for this prospective study. Inclusion criteria was a period of 2-8 weeks after PCI. The cohort was divided into two groups: the Cardiac rehabilitation group (CRG) who received a traditional cardiac rehabilitation program (n=35) and the Nordic Walking group (NWG) (n=34). All patients were prescribed double antithrombotic therapy, hypertensive and hypolipidemic drugs.

At the 1st and 12th weeks we performed a cardiac stress test ((EPI) Astrocard® "CardioEPI" (Polysystem-EP/L); Bruce protocol treadmill stress test) and echocardiography.

We evaluated the following parameters: resting heart rate (rHR), resting systolic blood pressure (rSBP), and resting diastolic blood pressure (rDBP); maximum HR (HRmax) and BP (BPmax); recovery-phase HR (rpHR) and BP (rpSBP, rpDBP); total test time (TTM, minutes); HR recovery time (HRt) and BP recovery time (BPt); exercise tolerance (MET).

The echocardiography was recorded on Mysonou 6 ™ (Korea). We evaluated end-systolic dimension (ESD, cm); end-diastolic dimension (EDD, cm); end-systolic volume (ESV, ml); end-diastolic volume (EDV, ml); left ventricular mass index (LVMI, mm); left atrial size (LA, mm); interventricular septum (IVS, mm); systolic volume (SV, ml); left ventricular ejection fraction (EF, %).

The duration of the cardiac rehabilitation course was 12 weeks. Each patient attended 3 sessions per week. There were 5-8 persons in each group. The duration of the mixed training, which included resistance exercises with aerobic activity, was from 45 minutes to 1 hour. There were fifteen minutes of therapeutic exercises at the start of training in the control group, which included concentric, eccentric, and static exercises. In the NWG patients walked for 35-40 minutes (Gabel Stretch model). At the end of training patients performed stretching and breathing exercises to return HR and BP to an initial values.

Heart rate was measured by heart rate monitor Polar FT1®. After training we used the Astrocard® Polysystem-FS in the cardiac stress tests at average intensity (4.5±0.5 km/h) for 30 minutes.

Data management and analysis were performed using the Statistical Package for Social Sciences (SPSS) for Windows, version 20.0 (IBM Inc., New York, US).We used the Mann-Whitney test and Wilcoxon signed ranks test for comparing the mean of outcomes.

3 Results

In tables 1 and 3 we summarized echocardiography and treadmill test values and colored the most significant parameters.

Tables 2 and 4 show the comparison between CRG and NRG after 12 weeks. After 12 weeks of the out-patient cardiac rehabilitation program in the CRG there were changes in ESD (from 3.6±0.6 to 3.4±0.5; p=0.01), ESV (from 128.8±32.1 to 117±26.5; p<0.001), EDV (from 57.6±18.5 to 48.7±21.4; p<0.001), and LVMI (from 119.3±24.6 to 99. 1±18.1; p<0.001) levels. At the same time we noticed a significant increase in SV (from 61.5±14.8 to 69.9±13.0; p<0.001) and EF (from 55±8.3% to 60.6±8.2%; p<0.001). The most significant changes are highlighted. As well as in the NWG we found an increase in ESD (from 3.5±0.5 to 3.3±0.4; p=0.09), a significant decrease in LVMI (from 119.2±28,3 to 107.7±28.0; p<0.001) and LA sizes (from 3.9±0.4 to 3.8±0.3; p<0.001), and a significant increase in SV (from 68.2±16.1 to 79.0±14.4; p<0.001) and EF (from 58.0±7.7 62.0±5.7%; p<0.001). Treadmill stress tests in the CRG showed a decrease in rHR (from 72.9±10.3 to 67.9±6.1; p=0.04) and a significant increase in TTM (from 5.0±1.9 to 6.7±2; p<0.001) and in MET (from 4.0±1.5 to 5.0±1.7; p<0.001). Relatively close results we obtained in the NWG: a decrease in rHR (from 74.5±11.2 to 71.5±11.0; p=0.041) and a significant increase in TTM (from 5.2±1.8 to 7.3±2.0; p<0.001) and in MET (from 4.0±1.0 to 5.3±2.0; p<0,001).

Table 1. Echocardiography values before the rehab.

Echocardiography values	Before (CRG)	Before (NWG)
EDD, cm	5±0.6	5.1±0.5
ESD, cm	3.6±0.6	3.5±0.5
EDV, ml	128.8±32.1	122.3±27.6
ESV, ml	57.6±18.5	51.6±17.3
LVMI*	119.3±24.6	119.2±28.3
LA, cm*	4±0.4	58,0±7.7
E/A*	1±0.4	3.9±0.4
EF %*	55±8.3%	0.9±0.3
SV, ml*	61.5±14.8	68.2±16.1

Note. * p<0.001

Table 2. Echocardiography values after the rehab.

Echocardiography values	After (CRG)	After (NWG)
EDD, cm	4.9±0,5	5.0±0.5
ESD, cm	3.4±0.5	3.3±0.4
EDV, ml	117±26.5	121.8±25.6
ESV, ml	48,7±21.4	47.1±15.1
LVMI*	99.1±18.1	107.7±28.0
LA, cm*	3.8±0.4	62.0±5.7
E/A*	1.1±0.5	3.8±0.3
EF %*	60.6±8.2%	1±0.4
SV, ml*	69.9±13.0	79.0±14.4

Note. * p<0.001

Table 3. Treadmill values before the rehab.

Treadmill values	Before (CRG)	Before (NWG)
rHR	72.9±10.3	74.5±11.2
HRmax	112.9±14.9	114.8±17.0
rpHR, minutes	4.1±1.2	3.9±0.9
rSBP	117.5±16.2	115.1±15.6
rDBP	76±8,8	75.7±7.0
SBPmax	149.6±23.3	156.7±21.2
DBPmax	82.3±8.4	83,4±5.9
BPt	4.2±1.1	3.9±0.9
TTM, minutes*	5.0±1.9	5.2±1.8
MET*	4.0±1.5	4,0±1.0

Note. * p<0.001

Table 4. Treadmill values after the rehab.

Treadmill values	After (CRG)	After (NWG)
rHR	67.9±6.1	71.5±11,0
HRmax	114.1±13.5	121.3±18.7
rpHR, minutes	3.,8±1	3.9±0.9
rSBP	116.5±16.2	110.9±14.4
rDBP	77±13.2	72.9±7.9
SBPmax	151.9±19.6	156.3±22,2
DBPmax	82.3±5.9	82.0±5.8
BPt	3.8±1	3.8±0.9
TTM, minutes*	6.7±2	7.3±2.0
MET*	5.0±1.7	5.3±2.0

Note. * p<0.001

4 Conclusion

Physical activity stimulates myocardial remodeling [21, 22], but so far there is still no strong evidence about the pathway it works. On the one hand, more attention has focused on the decrease of the angiotensin II, aldosterone, vasopressin, atrial natriutic peptid, epinephrine, and norepinefrin blood levels by physical exercises [23-25], which leads to a reduction of the hemodynamic load. Our results are in line with those of previous studies indicating that both typical cardiac rehabilitation programs and cardiac rehabilitation programs with Nordic Walking significantly decrease LVMI. On the other hand, several studies have also shown that the benefits of physical activity arise from improvements in myocardial contractility, diastolic function, or systolic or diastolic wall stress [26, 27]. The results of our study indicate that EF and SV significantly increased in both groups of our cardiac rehabilitation program. EF in the control group improved from 55±8,3% to 60,6±8,2%; p<0,001 and in the Nordic Walking group increased from 58,0±7,7 to 62,0±5,7%; p<0,001. Similar beneficial results were obtained for the SV (from 61,5±14,8 to 69,9±13,0; p<0,001 in the first group and from 68,2±16,1 to 79,0±14,4; p<0,001 in the Nordic Walking group). Both cardiac rehabilitation programs are more or less equal in their efficacy, but there are some additional benefits from NW training. The outstanding feature of the Nordic Walking is that the use of poles during walking involves muscles of the upper body and arms. An enhanced arm movement improves balance and oxygen consumption [28]. An additional benefit of NW is a reduction of the lower limb and joints loading, which is significantly important in elderly patients [29]. Another important effect of NW in the rehabilitation program is increased exercise capacity [30]. We found that both cardiac rehabilitation groups saw a significant increase in MET and TTM, but with slightly greater improvement in the NW group. Moreover, rHR significantly decreased in both groups. At the same time there is a strong correlation between MET and mortality risk. According to previous studies, the reduction in mortality risk per MET could vary between 10% and 25% [31,32].

Further, the difference between a typical cardiac rehabilitation program and a rehabilitation program with NW is the location of the activity. For example, NW training is usually performed outdoors whilst most of the typical cardiac rehabilitation programs are performed indoors. It has been demonstrated that outdoor natural environments have a greater beneficial effect on physical and mental wellbeing than physical activity carried out indoors [33]. There are no seasonal limitations for NW, so patients could perform NW in parks, stadiums, and public gardens. All the more, some patients would certainly prefer NW to more costly gym visits.

We could suggest that rehabilitation programs with NW could be as effective as traditional ones, but patients might experience additional benefits, as we have already mentioned. Patients could learn how to work with NW poles from their sports medicine physician or physiotherapist and then to perform NW on their own.

The echocardiography data from the treadmill stress tests proved the possibility of using NW at the final stage of rehabilitation. NW could therefore be considered for inclusion in the international guidelines for cardiac rehabilitation, as well as ordinary walking and aerobic and resistance exercises.

Acknowledgments

The authors would like to express their sincere gratitude to all participants in the study, as well as to Mr. Michal Paul Laird, who gave his invaluable assistance in editing of the paper.

Disclosures

The authors declare no potential conflict of interests regarding the content of this paper.

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