Original article

THE EFFECTS OF PHYSICAL TRAINING ON CARDIOVASCULAR PARAMETERS AND REDUCTION OF VISCERAL FATTY TISSUE

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Regular physical activity and good physical condition are widely accepted as factors that reduce all-cause mortality and improve a number of health outcomes.
The aim of this study was to investigate the effects of aerobic exercise training on cardiovascular parameters and reduction of visceral obesity in patients with stabile coronary artery disease participating in a cardiovascular rehabilitation exercise program. Fifty-two patients with stable coronary heart disease who had been accepted into the outpatient Phase II cardiovascular rehabilitation program at the Institute for Treatment and Rehabilitation of Cardiovascular Diseases Niska Banja, Nis, Serbia, were recruited for this study. All patients were divided into two groups: group with stable coronary heart disease who had regular aerobic physical training during 6 weeks and control without physical training. There were not significant differences in body weight, body mass index, waist circumference and waist /hip ratio in start and at the end of physical training program. Physical training did not reduce the above mentioned parameters after 6 weeks. There were not significant differences in systolic and diastolic blood pressure at the beginning and at the end of the observed period. In group with physical training, a significant reduction of systolic and diastolic blood pressure after cardiovascular rehabilitation were reported ($p<0.05$). In patients with moderate aerobic physical training, a significant decrease in the heart rate was registered after the 6-week follow-up ($p<0.05$), while heart rate was significantly lower in this group compared to group with sedentary lifestyle ($p<0.05$). The effects of the 6-week cardiovascular rehabilitation on lipid parameters is visible only in slight reduction of triglyceride values in group with physical training ($p<0.05$). The concentration of triglycerides were significantly lower in this group compared to sedentary patients after the 6-week follow-up ($p<0.05$).

Dynamic training can improve blood pressure in patients with moderate to severe hypertension and reduce the need for medication. Exercise programs induced favorable adaptations on total cholesterol, triglycerides, and body composition. *Acta Medica Medianae 2007;46(4):34-37.*

Keywords: *physical activity, cardiovascular parameters, obesity*

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Introduction

Regular physical activity and good physical fitness are widely accepted as factors that reduce all-cause mortality and improve a number of health outcomes (1). Exercise training, the major component of cardiac rehabilitation, reduces the risk factors, improves functional capacity and prognosis, and enhances psychosocial well-being and quality of life in patients suffering from coronary artery disease (CAD) (2). A recent study showed that low maximal aerobic capacity is closely related to an increase of untoward cardiac events (3). Therefore, physical training has been proposed to reduce these events by improving aerobic capacity. However, the association between training response and cardiovascular autonomic function is largely unknown. Laitinen et al. (4) have shown blood pressure (BP) to be negatively associated with age, body mass index (BMI), and baroreflex sensitivity and positively associated with BP variability. Blood pressure variability and haert rate variablity are shown to be an independent predictor of cardiovascular mortality and idicators of autonomic cardiovascular function (4).

In assessing exercise, both the frequency and the intensity of the exercise are important. Exercise training is generally categorized as being of low intensity (less than 45% of maximal oxygen uptake), moderate intensity (45-60% of maximal oxygen uptake), vigorous intensity (61-75% of maximal oxygen uptake) and strenuous intensity (greater than 75% of maximal oxygen uptake). Moderate-intensity exercise, for example,

corresponds to an exercise that elicits 60-70% of maximal heart rate (5). In a typical 40-year-old Canadian (of either sex), this corresponds to a heart rate of 110 to 125 beats/min.

Aim

The aim of this study was to investigated the effects of aerobic exercise training on cardiovascular parameters and reduction of visceral obesity in patients with stabile coronary artery disease participating in a cardiovascular rehabilitation exercise program.

Patients and methods

Fifty-two patients with stable coronary heart disease who had been accepted into the outpatient Phase II cardivascular rehabilitation program at the Institute for Treatment and Rehabilitation of Cardiovascular Diseases Niska Banja, Nis, Serbia, were recruited for this study. All patients were divided into two groups:

I group - 22 patients with stable coronary heart disease who had regular aerobic physical training during cardiovascular rehabilitation programe phase II along 3 weeks in rehabilitation center and 3 weeks after that at home of patients.

II group control- 30 patients with stable coronary heart disease who practice only regular usual house work without recommended aerobic physical training during the last 6 weeks before examination.

Patients were eligible to participate if they had a history of any of the following: myocardial infarction (MI), coronary revascularization, angiographic evidence of more than 50% stenosis in one or more coronary vessels. Subjects were excluded from participation in the study if they had uncontrolled arrhythmias, hypertension (systolic blood pressure >180 mmHg or diastolic BP >100 mmHg), unstable angina pectoris, poorly controlled congestive heart failure, abnormal hemodynamic response or ischemic electrocardiogram changes during stage 1 of the exercise tolerance test (Bruce protocol), or uncontrolled metabolic disease (e.g. uncontrolled diabetes or thyroid disease).

All cardiac related medication doses were kept constant throughout the study (all patients were on therapy by beta blockers, ACE inhibitors and statins), and patients were required to refrain from any change in their habitual diet.

Exercise training protocol

Patients underwent 6 weeks of aerobic exercise training consisting of 45 min sessions of continuous aerobic exercise on a treadmill, stationary bicycle or a walking. The intensity was maintained at 70–80% of the individual maximum heart rate obtained in the pre-study graded exercise test. All patients trained 3 times/week for 6 weeks.

Biochemical examination were done after 6 weeks of starting physical exercise training and compared with control group. Blood samples were collected at least 24 h after the last bout of exercise in order to avoid the immediate (acute) effects of exercise.

Cardiovascular parameters comprise measuring of systolic and diastolic arterial tension. Upon arrival, the subjects remained resting in a siting position for 5 min before the start of measuring. Blood pressure was measured by auscultation (sphygmomanometer and stethoscope, Becton Dickinson, USA) three times accordingly to American Heart Association procedure and the average values were adopted (6).

The values of arterial tension were obtained as average values of three consecutive measurements on left forearms. Besides arterial tension measurements, we simultaneously determined the heart rate.

Anthropometry

Fasting body weight, body height, waist and hip circumference were measured. Body mass index (BMI) was calculated as kg/m^2. We also calculated waist/hip ratio (WHR).

The data were analysed by standard descriptive methods (mean, standard deviation and percent frequency). Results were obtained by using Student t test, Hi^2 test and Fisher test depending on specimens and type of data.

Statistical analysis were done by software package SPSS 11.0.

Results

Table 1. Characteristics of patients

	Physical training	Control	p
Male/female (N)	7/10	6/6	NS
Age (years)	56.3±5.7	60.8±9.2	NS

Data are presented as the mean±S.D.

There were not significant differences in body weight, body mass index, waist circumference and waist/hip ratio at the start and at the end of physical training program. Physical training did not reduced the above mentioned parameters after 6 weeks (Table 2).

Table 2. Anthropometric data

	Physical training	Control	p
TT start (kg)	78.5±14.2	71.2±11.1	NS
TT end (kg)	75±12	68.6±10.5	NS
TV (cm)	162.6±7.5	166.8±5.34	NS
BMI start (kg/m^2)	28.56±5.14	25.92±4.66	NS
BMI end (kg/m^2)	27.32±4.55	24.06±2.7	NS
OS start (cm)	94.86±11.6	88.25±7.8	NS
OS end (cm)	93.4±10.9	88.8±6.6	NS
WHR start	0.88±0.04	0.89±0.05	NS
WHR end	0.88±0.04	0.9±0.05	NS

Data are presented as the mean±S.D.
TT-body weight; TV-body height; BMI-body mass index; OS-waist circumference, WHR-waist/hip ratio,

There were not signifficant difference in systolic and diastolic blood pressure at the start and at the end of the observed period. In the group with physical training,a signifficant

reduction of systolic and diastolic blood presure after cardiovascular rehabilitation were registred (p<0,05). In patients with moderate aerobic physical training, a significant decreasing of heart rate was registred after 6-week follow up (p<0,05), while heart rate was significantly lower in this group compared to group with sedentary lifestile (p<0,05) (Table 3).

Table 3. Cardiovascular parameters

	physical training	control	p
sTA start (mmHg)	144.7±5.8	139.1±4.9	NS
sTA end (mmHg)	136.1±4.3*	131±6.4*	NS
dTA start (mmHg)	90.15±6.8	85.8±6.6	NS
dTA end (mmHg)	82.5±5.2*	84±8.9	NS
SF start	77.6±13	74.5±9.5	NS
SF end	72.3±5.6*	75.6±7.5	<0.05

Data are presented as the mean±S.D.
sTA-sistolic arterial tension; dTA-diastolic arterial tension; SF-heart rate
*p<0.05 vs. starting data

The effects of the 6-week cardiovascular rehabilitaion on lipid parameters is visible only in slight reduction og trigliceride values in group with physical training (p<0,05). The concentration of triglycerides was significantly lower in in this group compared to sedentary patients after the 6-week follow up (p<0,05) (Table 4).

Table 4. Lipids' parameters

	fizički trening	kontrola	p
TC start (mmol/l)	5.3±0.7	5.4±0.44	NS
TC end (mmol/l)	5±0.8	4.9±1.7	NS
LDL-C start (mmol/l)	3.2±0.6	3.58±0.3	NS
LDL-C end (mmol/l)	2.9±0.28	3.3±0.6	NS
HDL-C start (mmol/l)	0.98±0.2	1.2±0.4	NS
HDL-C end (mmol/l)	0.97±0.2	1.1±0.2	NS
TG start (mmol/l)	1.78±0.5	1.7±0.2	NS
TG end (mmol/l)	1.58±0.3*	1.8±0.4	<0.05

Data are presented as the mean±S.D.
TC-total cholesterol; TG-triglicerids
*p<0.05 vs. starting data

Discussion

In groups of patients with similar age and gender distribution (Table 1), the anthropometric parameters did not show any significant difference (Table 2). Meanwhile, the comparison between the starting values and values at the end of the 6-week follow-up period did not show any significant difference. Similar findings of anthropometric parameters value after 6 weeks of physical training are presented by other authors (7) who did not show any important reduction of degree of total and visceral obesity measured by BMI, OS and WHR.

Moderate aerobic physical training did not lead to any significant change in systolic and diastolic blood pressure between the examined groups. The only significant finding was a lower heart rate in the group with physical training at the end of the follow-up period (Table 3). Obviously, there were trends in reduction of blood pressure in both groups, but a significant reduction was reported only in the group with physical training.

There is consistent evidence that a regular rhythmic physical exercise of the lower extremities decreases both systolic and diastolic blood pressure by 5–7 mm Hg independent of weight loss, alcohol intake or salt intake (8). These results of exercise training did not seem to be affected by the type of aerobic training because several studies used home training programs (9) and found comparable reductions in blood pressure to those in which subjects trained under staff supervision (10).

Thus, it appears that the antihypertensive effects of exercise are additive with those of most antihypertensive medications (11). It has been shown that chronic NO-deficient hypertension is associated with depletion of antioxidants and oxidative injury to the cardiovascular system and exercise training normalizes the BP by scavenging free radicals/ROS through up-regulation of cardiac NO and antioxidant systems (12). It is hypothesized that interaction of exercise training and chronic nitroglycerin treatment would maintain/regulate the BP through the up-regulation of NO and cardiac antioxidant system in rat (13).

Heart rate was lower in group with moderate aerobic physical training after 6 weeks compared to the starting values, but in the control group, the opposite trend was registered and a significant increase of heart rate was registered after 6 weeks of follow up (Table 3). These results are in line with similar study conducted by Antan et al. They found reduction of blood pressure and decreasing of heart rate in physically-active smokers compared to sedentary smokers (14).

A slight reduction of triglyceride concentration in group with physical training (Tabele 4) are in the line with results in literature. Training programs revealed positive adaptations on body composition and lipid profile (TC and TG). In particular, body weight is decreased by 1.7%-2.0% after 16 weeks of physical training. Exercise groups significantly reduced total cholesterol (-7.0 mg%) and triglycerides (-14.5 mg%) (15). Similar finding are registered in diabetics with physical activity (16). Reduction of lipid parameters and visceral obesity by physical training program and dietetic regiment are in the basis of secondary prevention of coronary heart disease (17).

Conclusion

Dynamic training can improve blood pressure in patients with moderate to severe hypertension and reduce the need for medication.

Exercise programs induced favorable adaptations on total cholesterol, triglycerides, and body composition.

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EFEKAT FIZIČKOG TRENINGA NA KARDIOVASKULARNE POKAZATELJE I REDUKCIJU VISCERALNOG MASNOG TKIVA

Tatjana Ilić, Biljana Vitošević, Branislava Ranković, Lidija Stević i Todorka Savić

Redovna fizička aktivnost i dobra fizička kondicija su dobro poznati i prihvaćeni faktori koji smanjuju ukupan mortalitet i poboljšavaju ishod brojnih oboljenja. Cilj rada bio je da se ispita efekat umerenog aerobnog fizičkog treninga na kardiovaskularne pokazatelje i redukciju visceralnog masnog tkiva kod bolesnika sa stabilnom koronarnom bolešću.

U istraživanje je uključeno 52 bolesnika obolela od koronarne bolesti, lečenih u Institutu za rehabilitaciju kardiovaskularnih bolesnika Niška Banja. Svi bolesnici su podeljeni u dve grupe: grupa sa stabilnom koronarnom bolešću i redovnim aerobnim fizičkim treningom tokom šest nedelja i kontrola sa stabilnom koronarnom bolešću bez fizičke aktivnosti. Nije registrovana razlika u telesnoj težini, indeksu mase tela, obimu struka i odnosu struk/kuk na početku i kraju ispitivanja. Između ispitivanih grupa bolesnika nije registrovana značajnija razlika u vrednostima sistolnog i dijastolnog krvnog pritiska na početku i na kraju programa kardiovaskularne rehabilitacije. U grupi sa fizičkim treningom dolazi do značajnog pada sistolnog i dijastolnog krvnog pritiska ($p<0.05$) nakon sprovedenog programa rehabilitacije fizičkom aktivnošću. Prosečna vrednost srčane frekvencije je u grupi sa fizičkim treningom značajno manja nakon šest nedelja praćenja ($p<0.05$), i znatno manja u odnosu na grupu sa sedentarnim načinom života ($p<0.05$). Fizički trening dovodi do značajne redukcije triglicerida ($p<0.05$) i njegove značajno manje vrednosti u ovoj grupi u odnosu na sedentarnu kontrolu nakon perioda praćenja ($p<0.05$). Aerobni trening umerenog intenziteta popravlja krvni pritisak kod koronarnih bolesnika sa umerenom do izraženom hipertenzijom i redukuje potrebu za uzimanjem antihipertenziva. Fizička aktivnost redukuje nivoe triglicerida i holesterola i dovodi do pozitivnih promena u kompoziciji tela. Acta Medica Medianae 2007;46(4):34-37.

Ključne reči: *fizički trening, kardiovaskularni pokazatelji, gojaznost*