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The Effect of 3-Weeks Stationary Cardiac Rehabilitation on Plasma Lipids Level in 444 Patients with Coronary Heart Disease

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A B S T R A C T

The aim of this study was to investigate the effect of 3- weeks stationary cardiac rehabilitation on plasma lipids level in patients with CHD. The study included 444 consecutive patients (364 male and 80 female, mean age 58±9 year) with CHD who underwent 3-weeks stationary cardiac rehabilitation. Patients were divided into groups depending on their baseline levels of cholesterol and medication therapy: patients with normal (< 5 mmol/L, group I, 129 patients) and elevate plasma level of Total cholesterol (> 5 mmol/L, group II, 315 patients) and subgroups Ia and IIa (with statin in therapy), Ib and IIb (without statin in therapy). After 3-weeks cardiac rehabilitation, the levels of Total cholesterol 5.75±1.34 vs. 5.17±1.08 mmol/l; p<0.001, triglycerides 2.04±1.33 vs. 1.81±1.06 mmol/L; p=0.004, LDL-cholesterol 3.77 ±1.14 vs. 3.21±0.96 mmol/L; p<0.001 were significantly lower while the level of HDL- cholesterol 0.94±0.28 vs. 0.99±0.27 mmol/L; p=0.008 were significantly higher in comparison with the baseline values. Furthermore, we found significant changes in lipid profile at the end of rehabilitation in each group of patients compared with the baseline values. There were no significant differences in plasma lipids level between group of patients with or without statin in therapy at the end of rehabilitation. The results of this study suggest that moderate regular physical activity and diet alone or in combination with hypolipidemic drugs already after 3 weeks have a favourable effect on plasma lipids level and should be propagate in the prevention of CHD.

***Key words**: lipids, cholesterol, triglycerides, rehabilitation, coronary heart disease*

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Introduction

Coronary heart disease (CHD) has an outstanding socioeconomic character in contemporary countries because of the very high rate of morbidity and mortality. In the United States of America, about 1.5 million people per year get ill from acute myocardial infarction (MI)[1]. In the recent European Heart Survey, mortality in patients presenting with ST- elevation acute coronary syndromes was 8.4% at 1 month[2]. Genetics factors, hyperlipidemia, hypertension, cigarette smoking, diabetes mellitus, obesity, physical inactivity and stress are the most important risk factors for CHD[3–5]. Besides other treatments, many studies confirmed the importance of aggressive lowering of the plasma lipids in the primary and secondary prevention of the CHD[6,7]. In recent available literature, the data about influence of combined exercise training, diet and hypolipidemic medication therapy during stationary cardiac rehabilitation on the plasma lipids level of the patients with CHD lacked.

Therefore, the aim of this study was to investigate the effect of 3-weeks stationary cardiac rehabilitation on plasma lipids level in patients with CHD.

Patients and methods

Patients eligible for this prospective study were 467 patients with CHD during 3-weeks stationary cardiac rehabilitation (mean duration 19±2 day). There were 332 (71%) patients who had myocardial infarction (MI), 117 patients (25%) who underwent coronary artery bypass grafting (CABG) and 18 patients (4%) who underwent percutaneous coronary intervention (PCI), respectively. The average body weight of the patients were 83±14 kg and average body mass index (BMI) were 27.6±3.3 (range 21.1– 36.5). Seventy-eight percent of the patients had BMI = 25 and 18% had BMI = 30, respecitvely. The patients were acquainted with the protocol of the study and written informed consent was obtained from the each patient.

Blood samples were taken in every patient the next day after admission and at the last day of rehabilitation. The patients were divided into the groups dependent on their baseline values of Total cholesterol[8] and medication therapy before the start of the rehabilitation. The design of the study is present on the Figure 1.[9] Medication during rehabilitation is present in Table 1.

Plasma Total cholesterol and triglycerides levels were determined by enzymatic colorimetric (PAP) method. LDL-cholesterol level was calculated by using Friedewald formula (LDL cholesterol (mmol/l) = Total cholesterol – triglycerides/2.2 – HDL--cholesterol)[10] and HDL- cholesterol level was determined by using selective precipitation method with magnesium chloride.

After determination of baseline lipid profile, the patients started with rehabilitation. Rehabilitation program included conditioning on cycle ergometer, supervised group exercise and distance limited exercise walking. Rehabilitation was practized six days a week, with resting on Sunday's. Exercise level on cycle ergometer was determined according to the results of the symptom – limited exercise test at admission. Symptom – limited exercise test was done on cycle ergometer with initial workload of 25 W which progressive increase for 25 W each 2 minutes. In general, the intensity of daily exercise of the patients on the cycle ergometer were 70–85% of their peak heart rate achieved on the initial exercise test. The conditioning on cycle ergometer was started the next day after the initial exercise test, two times daily. On the first day, patients started conditioning with 6 one minute rounds, with one minute resting between every round. If there were no contraindications, every 3 days the number of one

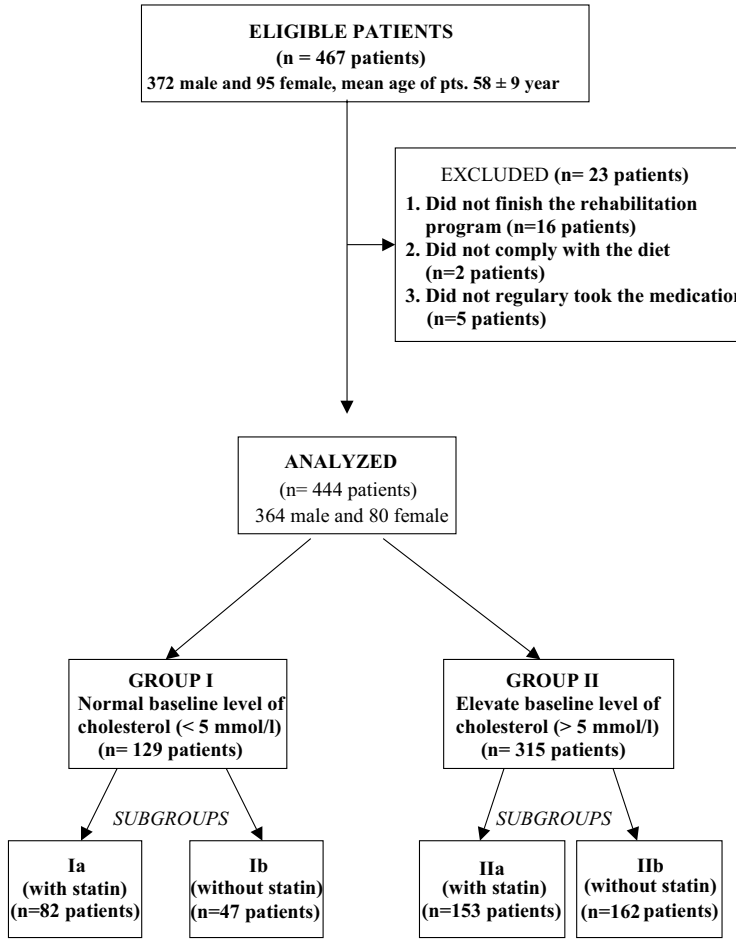

Fig. 1. The diagram of the study design.

minute round were progressively increased up to a maximum number of 14. Besides conditioning on cycle ergometer, group exercise of breathing, stretching, relaxation, muscle strenghthing were done under supervision of a physiotherapist duration of 30 minutes daily. Furthermore, the distance-limited walking (1500 up to 2500 m at the end of rehabilitation) were also done daily under supervision of a physiotherapist. Diet comprised the reduction of the overall energy intake on approximately 1600 ccal per day with up to 35% nonsaturated fatty acid.

Statistical analysis was performed by using the commercial software package, SPSS for Windows, Version 10.0. The results are expressed by mean values ± standard deviation and percentage of change of each plasma lipids level at the end of rehabilitation in comparison with baseline values. The differences between the groups were tested by analysis of variance with repeated measures. The va-

TABLE 1
MEDICATION DURING CARDIAC REHABILITATION

Group of drugs	N	%
Statins	235	53
Aspirin	419	94
Angiotenzin-converting enzyme inhibitors	302	68
Beta adrenergic blockers	173	39
Diuretics	102	23
Long acting nitrates	121	27
Calcium channel blockers	79	18
Digitalis	26	6
Antiarrhythmic (class Ic and III)	62	14
Oral anticoagulants	53	12

lue of $p<0.05$ was considered statistically significant.

Results

After 3-weeks cardiac rehabilitation, the levels of Total cholesterol 5.75±1.34 vs. 5.17±1.08 mmol/l; $p<0.001$, triglycerides 2.04±1.33 vs. 1.81±1.06 mmol/L; $p=0.004$, LDL-cholesterol 3.77±1.14 vs. 3.21 ±0.96 mmol/L; $p<0.001$ were significantly lower while the level of HDL-cholesterol 0.94±0.28 vs. 0.99±0.27 mmol/L; $p=0.008$ were significantly higher in comparison with the baseline values. We found significant changes in lipid profile at the end of rehabilitation in each group of patients compared with the baseline values (Table 2.). Furthermore, there were no significant differences in the baseline and level of plasma lipids at the end of rehabilitation between patients in the group Ia vs. Ib or IIa vs IIb, respectively.

Discussion

The results of this study clearly show that already after 3-weeks moderate regular physical activity and diet, the level of Total cholesterol, triglycerides and LDL-cholesterol significantly decreased while the level of HDL-cholesterol significantly increased. These results are in accordance with the previous studies which pointed that physical activity and diet have a favourable effect on the plasma lipids level[11–14]. Besides exercise and diet, by including some of the hypolipidemic drugs in the medication therapy, it could obtain a more favourable effect on the regulation of the plasma lipids level. It is interesting that we found that regular exercise improved lipid profiles similarly in patients with statin in therapy and in patients without statin. The study of Blumenthal J.A. et al. suggests that the intensity of the exercise training have no significant influence on the plasma lipids level of the CHD patients, meaning that exercise training of low intensity have a similar effect on the plasma lipids level like exercise training of high intensity[15]. Furthermore, Lavie C.J. et al. reported that cardiac rehabilitation have a favourable effect on the lipids profile of the very elderly CHD patients, the patients who are older than 75 [16]. Doubtless, regular exercise training by decreasing the level of Total cholesterol, triglycerides and LDL-cholesterol and by increasing the level of HDL-cholesterol at least partially affected on reduction of the late mortality rate after MI[17]. Because of the effect of the exercise training and other treatment during rehabilitation, The Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology (ESC) recommended referring cardiac rehabilitation to every patient after acute phase of MI with left ventricular dysfunction[18].

During the last decade, attitude about medication hypolipidemic therapy have significantly changed. Previous opinions about hypolipidemic therapy were controversial because of the lack of the large prospective studies about the influence of

TABLE 2
THE PERCENTAGE OF CHANGE OF EACH PLASMA LIPID LEVEL AT THE END OF REHABILITATION IN COMPARISON WITH BASELINE VALUES

Group of pts.	Cholesterol		Triglycerides		LDL-cholesterol		HDL- cholesterol	
	Baseline End of reh.	Differ. p	Baseline End of reh.	Differ. p	Baseline End of reh.	Differ. p	Baseline End of reh.	Differ. p
I	4.56±0.55 4.39±0.75	–4% 0.01	1.72±0.79 1.55±0.71	–10% 0.01	3.00±0.61 2.84±0.69	–5% 0.02	0.89±0.30 0.96±0.27	+7% 0.02
II	6.40±1.09 5.31±1.04	–17% <0.001	2.18±1.45 1.83±1.16	–16% <0.001	4.46±0.96 3.61±0.93	–19% <0.001	0.96±0.27 1.08±0.27	+11% 0.02
Ia	4.33±0.59 4.13±0.91	–5% 0.04	1.80±0.70 1.64±0.80	–9% 0.02	2.77±0.52 2.58±0.73	–7% 0.03	0.89±0.30 0.96±0.27	+7% 0.03
Ib	4.66±0.50 4.51±0.65	–3% 0.03	1.69±0.83 1.51±0.67	–11% 0.01	3.02±0.61 2.90±0.62	–4% 0.04	0.92±0.32 0.97±0.29	+5% 0.04
IIa	6.37±1.16 5.10±1.19	–20% <0.001	2.25±1.91 1.87±1.60	–17% <0.001	4.43±1.00 3.41±0.93	–23% <0.001	0.98±0.28 1.10±0.28	+12% 0.01
IIb	6.41±1.02 5.38±0.96	–16% <0.001	2.11±1.10 1.80±0.83	–15% <0.001	4.52±0.94 3.75±0.93	–17% <0.001	0.96±0.27 1.05±0.27	+9% 0.02

those drugs on survival after MI. The »4S« study (Scandinavian Simvastatin Survival Study) published 1994[7] is first and probably the most famous large prospective study which shows the importance of the aggressive lowering of the Total and LDL-cholesterol plasma level in the secondary prevention of CHD. After »4S« study, the investigators conducted and published many studies about the influence of other statins on the reduction of mortality and major coronary event rate. In general, these studies confirmed that »statin therapy« has played an important role in the prevention of CHD with the harmless of that long-term treatment [19–21]. Today in clinical practice, the standard is that the patients with established CHD and elevated plasma lipid levels be treated with some dose of statin, but the prescription of that group of drugs is also recommend in the primary prevention of CHD[20]. Furthermore, it is important to emphasize that statins, beside lowering the level of plasma lipids, have many other anty-atherosclerotic effects named »pleiotropic« which is the additional reason for the wide prescription of those drugs[22].

In conclusion, the results of this study suggest that moderate regular physical activity and diet alone or in combination with hypolipidemic drugs already after 3 weeks have a favourable effect on plasma lipids level and should be propagate in the prevention of CHD. Taking into consideration the results of this study and recommendation of the ESC[18], we conclude that the majority of the patients after acute phase of MI, CABG or PCI should routinely be referred to and encouraged to attend cardiac rehabilitation programs. The ambulatory exercise and preventive programs have to be continued to preserve the beneficial effects of phase II stationary cardiac rehabilitation.

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UTJECAJ TROTJEDNE STACIONARNE KARDIOLOŠKE REHABILITACIJE NA RAZINU LIPIDA PLAZME U 444 BOLESNIKA S KORONARNOM BOLEŠĆU

SAŽETAK

Normalizacija razine lipida u krvi ima važnu ulogu u prevenciji koronarne bolesti. Cilj rada bio je utvrditi utjecaj trotjedne stacionarne kardiološke rehabilitacije na lipidogram bolesnika s koronarnom bolešću. U studiju su uključena 444 uzastopna bolesnika (364 muškarca i 80 žena) prosječne dobi 58±9 godina s koronarnom bolešću tijekom provedbe trotjedne kardiološke rehabilitacije. Ovisno o inicijalnim vrijednostima kolesterola i medikamentnoj terapiji kod dolaska na rehabilitaciju, bolesnici su podijeljeni u skupine: bolesnici s inicijalno normalnim (<5 mmol/L, skupina I, 29% bolesni-

ka), povišenim vrijednostima kolesterola (>5 mmol/L, skupina II, 71% bolesnika) te podskupine Ia i IIa (uz statin u terapiji) te Ib i IIb (bez statina u terapiji). Lipidogram je određen prije početka te na kraju rehabilitacije. Rezultati su izraženi srednjom vrijednošću ± standardna devijacija te postotkom promjene razine svake pojedine frakcije lipida na kraju rehabilitacije u odnosu na inicijalne vrijednosti. U statističkoj analizi dobivenih rezultata je korištena analiza varijance s ponavljanim mjerenjima. Nakon provedene trotjedne rehabilitacije, vrijednosti kolesterola (5.75±1.34 vs. 5.17±1.08 mmol/l; p<0.001), triglicerida (2.04±133 vs. 1.81±106 mmol/L; p=0.004), LDL- kolesterola (3.77±114 vs. 3.21±096 mmol/L; p<0,001) su bile značajno niže dok su vrijednosti HDL-kolesterola (0.94±0.28 vs. 0.99±0.27 mmol/L; p=0,008) bile značajno više u odnosu na izmjerene inicijalne vrijednosti. Također, unutar svih skupina bolesnika nađene su značajne razlike u lipidogramu na kraju rehabilitacije u odnosu na inicijalne vrijednosti. Nije bilo značajne razlike u razini lipida plazme na kraju rehabilitacije između skupina bolesnika sa ili bez statina u terapiji. Rezultati ovog rada pokazuju da redoviti umjereni fizički trening i dijetna prehrana uz hipolipemičku medikamentnu terapiju već nakon tri tjedna povoljno utječu na pojedine frakcije serumskih lipida te ih treba propagirati u prevenciji koronarne bolesti.