Original article **UDC: 616.1-008:612.123]:613.73**
doi:10.5633/amm.2019.0205

CARDIOVASCULAR RISK REDUCTION AND CORRECTION OF HYPERLIPIDEMIA IN PATIENTS AT PRIMARY PREVENTION THROUGH PHYSICAL ACTIVITY

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Coronary heart disease is responsible for a high degree of morbidity and mortality in industrialized countries. Many countries have therefore adopted preventive measures to reduce the prevalence of major risk factors for coronary artery disease (CD): high serum cholesterol, high blood pressure, diabetes, and smoking.

The aim of this study was to determine the effects of physical training and diet on lipid and lipoprotein parameters in patients with hyperlipidemia without developed coronary heart disease.

The study included 45 patients, average age 56.1 ± 12.7 years. All patients had total cholesterol greater than 5.2 mmol/1, elevated blood pressure, and 16.42 % of respondents had used tobacco. Risk factors for the CD were evaluated through clinical history, anthropometric and cardiovascular parameters with the use of biochemical analysis. Lipid parameters included the determination of total cholesterol, triglycerides and HDL, LDL and VLDL cholesterol as well as lipid relations. All tested parameters were determined at the beginning and after the six months of testing. All patients were on a program of physical activity as recommended by ACC /AHA and on a diet according to NCEP ATP III recommendations for primary prevention of coronary heart disease.

After six months of testing, there was a change in the risk factors of lipid origin: triglycerides were reduced by 22.3 %, HDL-C was increased for 11.94 %, VLDL was reduced for 21.9 % and nonHDL-C for 8.09 %. By applying physical activity the target value of HDL-C > 1 mmol/1 was achieved in all patients. A high percentage of respondents achieved the target values for Tg < 2.3 mmol/1 (92.79 %) and for the atherogenic relation LDL-C/HDL-C < 5 (84.59 %). BMI was reduced for 8.06 % ($p < 0.05$) a systolic blood pressure for 12.8 % ($p < 0.03$).

In patients with hyperlipidemia without coronary heart disease and other risk factors for coronary heart disease, the achieved changes of lipoprotein levels are an indicator for the further implementation of non-pharmacological measures with the goal to reduce the risk for coronary events. Determination of lipoprotein profiles and atherogenic markers is very significant in the initial screening of dyslipidemia, monitoring the effects of physical activity and evaluating the risk for coronary heart disease.

Acta Medica Medianae 2019;58(2):27-32.

Key words: *physical activity, hyperlipidemia, primary prevention*

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Introduction

Coronary heart disease is responsible for large morbidity and mortality in industrialized countries.

Atherosclerotic process, the problem that has been studied even before 100 year, lies at the basis of this disease. In the last century the two very important hypotheses on the pathogenesis of this process have been made: thrombogenic and lipid.

The first link between cholesterol and atherosclerosis was established in 1841 when Vogel demonstrated the presence of cholesterol in atherosclerotic plaques.

In 1884 Carl VonRokitanskif made the thrombogenic theory, and in 1856 Virchov made the theory of response to endothelial damage.

In 1913, Anitschkov and Chalatov showed that a diet rich in cholesterol induced atherosclerotic

changes, and Goldstein and Brown identified LDL particles as main atherogenic lipoproteins. (2)

Based on the results of the Framingham Study, it became clear that lipid disorders, hypertension, diabetes, and obesity are major risk factors for CD.

Many countries have adopted the preventive measures in order to reduce the prevalence of major risk factors for coronary heart disease: high values of serum cholesterol, high blood pressure, diabetes and enjoying of tobacco. The coronary heart disease mortality rate in our country is increasing, while in developed countries this mortality rate of cardiovascular disease is significantly reduced below 50 % and in particular of myocardial infarction. (3) This was achieved by successful modification of risk factors for atherosclerosis (strict prohibition of smoking, aerobic physical activity, nutrition without cholesterol and saturated fatty acids, reduction of body weight in obese patients, treatment of hypertension and diabetes and lowering of elevated blood lipids by wide application of hypolipemics) (4).

The fact that two-thirds of the patients with coronary artery disease have a total cholesterol level in the serum of more than 5.17 mmol/1, LDL-C > 3.35 mmol/1 and HDL-C < 0.91 mmol/1.2 confirms that hyperlipidemia is one of the most important risk factors for CHD. (5)

Implementation of recommendations for changes in lifestyle, diet, and the increase of physical activity in patients with dyslipidemia is an initial measure in the treatment of patients with hyperlipidemia, which to a significant extent, reduces both non-lipid and lipid risk factors for CHD. This justifies the long-term use of non-pharmacological measures at primary and secondary prevention of coronary heart disease. If these measures do not show the desired results, antilipemic medications should be added to therapy. (6)

The aim of the research

To determine the effects of the use of physical training and diet on lipid parameters in patients with hyperlipidemia without a developed coronary heart disease.

Material and methods

In total, 45 persons of both sexes and average age 56.1 ± 7.12 years were examined. All the patients had total cholesterol greater than 5.2 mmol /1, elevated blood pressure, and 16.42 % of the respondents enjoyed the tobacco. The initial clinical examination of subjects included the registration of history data, based on questionnaires of the Cabinet for the disorder of fat metabolism at the Institute for prevention, treatment, and rehabilitation of rheumatic and cardiovascular diseases "Niška Banja", anthropometric measurements for calculating body mass index and registration of blood pressure.

Determination of total cholesterol, triglycerides, and HDL cholesterol, as well as non-lipid biochemical parameters (fibrinogen, uric acid, glucose), was performed by using standard methodology after twelve hours of fasting, and levels of LDL cholesterol, VLDL cholesterol, and lipid relations were determined by calculation. All of the examined parameters were determined at the beginning and after six months of testing. Based on the results of clinical examination and biochemical analysis, the lipid profile and risk factors of non-lipid origin for coronary heart disease were determined.

All patients were included in the outpatient program physical training program, which included physical activity for 45 minutes, five days a week, as recommended by the AHA for primary prevention (7).

In addition to physical training, the diet of the first degree was prescribed to the patients, (total fat intake < 30 %, energy intake < 10 %, saturated fatty acids, and cholesterol < 300 mg/a day) according to the recommendations of the NCEP ATP III (8). The research results were processed by using appropriate methods of descriptive statistics and were analyzed by using appropriate tests. The results are presented in tables and graphs.

Results

After a six-month physical training and diet, altered levels of lipid and non-lipid parameters were registered.

BMI was reduced for 8.06 % ($p < 0.005$), systolic blood pressure was reduced for 21.8 % ($p < 0.05$), diastolic blood pressure for 22.6 %.

Fibrinogen was lowered for 7.81 %, and uric acid for 9.71 %. There was a lowering of the glycemia for 9.89 %, by which the threshold of statistical significance was not reached (Table 1).

By implementation of physical activity and diet in patients with hyperlipidemia without coronary heart disease, the increase of HDL-C for 11.72 % ($p < 0.01$) was noted, the reduction of total cholesterol for 5.2 % was not significant, LDL-C was reduced for 31.4 % which also was not significant, triglycerides were reduced for 22.0 % ($p < 0.01$), VLDL was also reduced for 22.0 % ($p < 0.01$), while the nonHDL-C was reduced for 17.8 % ($p < 0.05$).

The regime of continuous physical activity and diet led to a significant reduction in atherogenic relation Hol/HDL-C (22.15 %, $p < 0.005$), the increase of HDL-ratio (21.45 %, $p < 0.005$) and reduction of atherogenic relation LDL-C/HDL-C (16.79 %, $p < 0.01$) (Table 2)

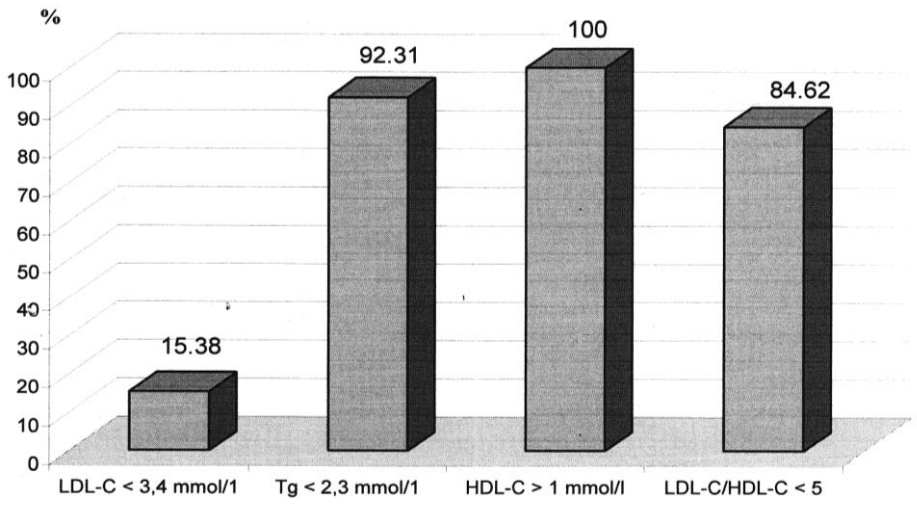
By applying the hygienic dietary therapy and physical activity in the duration of 6 months, all the participants have achieved the target values of HDL-C > 1 mmol/1. A very high percentage of respondents scored the target values for Tg < 2.3 mmol/1 (92.31 %) and for the atherogenic relation LDL-C/ HDL-C < 5 (84.62 %) (Graph 1).

Table 1. Changes of non-lipid origin risk factors during testing

Risk factors	The subjects with hyperlipidemia without coronary artery disease			
	Total		Difference	P
	The beginning	The end of testing	%	
BMI (kg/m^2)	29.54 ± 2.23	27.12 ± 1.53	-8.06	0.005
systolic blood pressure (mmHg)	147,6+ 15.36	135.28 + 12.16	-8.21	0.05
diastolic blood pressure (mmHg)	92.2 + 9.04	86.44 ± 6.88	-6.22	NS
fibrinogen (g/L)	3.73 + 0.72	3.42 ± 0.62	-7.81	NS
acidumuricum (umol /1)	265.4 ± 79.9	239.79 + 90.45	-9.71	NS
glycemia (mmol/1)	5.4 +1.1	4.8 + 0.5	-9,89	NS

Table 2. The change of lipid parameters values during testing

Lipid parametric relations	Subjects with hyperlipidemia without coronary artery disease			
	Total		Difference	P
	The beginning	The end of testing	%	
total cholesterol (Hol)	6.95 ± 0.45	6.58 ± 0.54	-5.2	NS
Triglycerides (TG)	2.23 ± 0.55	1.73 ± 0.29	-22.0	0.01
VLDL-C	1.01 ± 0.25	0.78 ± 0.13	-22.0	0.01
LDL-C	4.94 ± 0.57	4.67 ± 0.54	-4.31	NS
non-HDL-C	5.95 ± 0.49	5.47 ± 0.53 -	-8.17	0.05
HDL-C	1.00 +0.14	1.11 +0.07	±11.72	0.01
LDL-C/HDL-C	5.04 ± 1.01	4.18 ± 0.54	-16.79	0.01
Hol/HDL-C	7.08 ± 1	5.53± 1.51	-22.15	0.005
HDLratio *	0.16 ± 0.03	0.20 ± 0.02	+21.45	0.005



Graph1. Percentage of patients with achieved success

Discussion

Comparing the data of epidemiological studies of randomized clinical testings, it is revealed that it is highly possible to prevent coronary heart disease. Despite this fact, there is an alarming trend of prevalence and regulation of risk factors in women. The prevalence of obesity is increasing, and about 25 % of women do not practice regular physical activity. The rate of tobacco use is slightly increasing in women compared to men. Approximately 52 % of women > 45 years old have elevated blood pressure, and approximately 40 % of women > 55 years of age have elevated serum cholesterol levels (7).

Diabetes is a powerful risk factor in women, which leads to an increased risk for the occurrence of CHD 3 to 7 times as long as the increase in men 2 to 3 times. This difference between the sexes is present due to the extremely harmful effects of diabetes on lipids and blood pressure in women. Women tend to have higher levels of HDL-C compared to men, and triglyceride level may be a significant risk factor, especially in older women (9).

Physical activity in earlier sedentary respondents showed a small but significant drop in levels of cholesterol, LDL-C, and triglycerides which was accompanied by an increase in HDL-C level.

Long distance runners and other athletes, generally have high levels of HDL-C, especially HDL fractions. Sedentary men moderately increase the levels of HDL-C after 8-11 months of physical training. There is also evidence that physical training is associated with changes in the composition of LDL particles, transforming small dense atherogenic LDL particles to larger and lighter particles (10).

Physical training shows beneficial effects in those who adhere to the diet of first or second degree with the recommendations of the NCEP's.

Meta-analysis shows that physical exercise causes a greater reduction of total cholesterol, LDL-C and Tg, and the increase of HDL-C if it is accompanied by a low-fat diet. Stefanick and colleagues demonstrated that the subjects, with low HDL-C and high LDL-C, who were on a diet of the second degree, do not show a significant reduction in LDL-C without the use of physical training (10).

Bass and authors in the large study that evolved the role of HDL-C as a risk factor for cardiovascular disease in women, found that women with HDL-C < 50 mg/dl have nearly three times greater degree of mortality from cardiovascular disease. The negative correlation between the percentage of body fat or body mass and HDL-C was confirmed in premenopausal and postmenopausal women as well as in men. (11).

Physical training which is recommended for people at high risk for CHD, both at primary and secondary prevention, involves anaerobic, dynamic work with the aim to moderately increase the heart volume, ventilation, and consumption of oxygen.

Physical activity is a quick walk of 30-60 minutes, at least 3-4 times a week. It is a minimal level of physical activity in the prevention of CHD. Physical activity of high intensity and diet help to reduce cholesterol for 5-7 %, LDL-C for 7-12 % (12).

Physical activity, alone, leads to a reduction of triglyceride and LDL-C levels, and to a significant increase of HDL-C. The increase in HDL-C ranges from 5-16 % and is directly related to the levels of triglycerides, body mass, alcohol consumption, and smoking.

Intensive physical training leads to an increase in HDL-C among young people for 14 % and in the elderly, over 65years for 15 %, together with the reduction of other risk factors (13).

In ATP III recommendations, weight gain and obesity have been identified as major risk factors for CHD and are identified as direct targets that need to be regulated. Reduction of body weight affects the reduction of LDL-C and reduces all the risk factors in metabolic syndrome. Regular physical activity reduces the levels of VLDL, increases HDL-C, and in some patients reduces the levels of LDL-C. It can also reduce blood pressure, reduce insulin resistance and affect cardiovascular function. ATP III recommends physical activity as a routine component in the regulation of the high level of cholesterol in serum (8).

In our study of patients with hyperlipidaemia without CHD, there have been significant changes in the risk factors of lipid origin: triglycerides were reduced for 22.0 %, the increase of HDL-C for 11.72 % was recorded, VLDL was reduced for 22.0 % non-HDL-C 8.17 % . From risk factors of lipid origin, BMI pressure was significantly reduced for 8.17 %, and systolic blood pressure for 8.21 %.

The study on 3331 adults with physical activity at least 30 minutes, 3 times a week, showed that this group had significantly increased levels of HDL-C, lower triglyceride levels, significantly lower rates of smoking and lower BMI, compared to the group who led sedentary way of life, where the score of risk factors was significantly higher.

The group which practiced physical activity only once a week had a lower score for CHD risk factors, as compared to sedentary people.

Conclusion

1. Increased physical activity and dietary measures in patients with hyperlipidemia without coronary heart disease, lead to a reduction of lipid risk levels.

2. In patients with hyperlipidemia without coronary heart disease and other risk factors for coronary heart disease, the achieved changes of lipoprotein profiles are an indicator for the further implementation of non-pharmacological measures with the aim to reduce the risk for coronary events.

3. Determination of lipoprotein profiles and atherogenicmarkersis significant at the initial screening of dyslipidemia, monitoring of the effects of physical activity and estimation of the risk for coronary heart disease.

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Originalni rad **UDC: 616.1-008:612.123]:613.73**
doi:10.5633/amm.2019.0205

SMANJENJE KARDIOVASKULARNOG RIZIKA I KOREKCIJA HIPERLIPIDEMIJE KOD BOLESNIKA NA PRIMARNOJ PREVENCIJI NAKON FIZIČKE AKTIVNOSTI

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Koronarna bolest srca odgovorna je za visok stepen morbiditeta i mortaliteta u industrijalizovanim zemljama. Zbog toga su mnoge zemlje usvojile preventivne mere za smanjenje prevalencije glavnih faktora rizika za bolesti koronarne arterije (CD): visok nivo serumskog holesterola, visok krvni pritisak, dijabetes i pušenje.

Cilj ove studije je utvrditi efekte fizičkog vežbanja i ishrane na parametre lipida i lipoproteina kod pacijenata sa hiperlipidemijom bez razvijene koronarne bolesti srca.

Studija je obuhvatila 45 pacijenata prosečne starosti: 56,1 ± 12,7 godina. Svi pacijenti su imali ukupan holesterol veći od 5,2 mmol/l, povišen krvni pritisak, a 16,42 % ispitanika je koristilo duvan. Faktori rizika za CD procenjeni su kroz kliničku istoriju, antropometrijske i kardiovaskularne parametre uz korišćenje biohemijske analize. Parametri lipida uključuju određivanje ukupnog holesterola, triglicerida i HDL, LDL i VLDL holesterola, kao i odnosa lipida. Svi testirani parametri određeni su na početku i nakon šest meseci testiranja. Svi pacijenti bili su na programu fizičke aktivnosti prema preporuci ACC/AHA i na ishrani prema preporukama NCEP ATP III za primarnu prevenciju koronarne bolesti srca.

Posle šest meseci testiranja došlo je do promene faktora rizika lipidnog porekla: triglicerid su smanjeni za 22,3 %, HDL-C je povećan za 11,94 %, VLDL je smanjen za 21,9 %, a nonHDL-C za 8,09 %. Primenom fizičke aktivnosti ciljna vrednost HDL-C > 1 mmol/1 postignuta je kod svih pacijenata. Visok procenat ispitanika postigao je ciljane vrednosti za Tg < 2,3 mmol/l (92,79 %) i za aterogeni odnos LDL-C/HDL-C < 5 (84,59 %). BMI je smanjen za 8,06 % ($p < 0,05$) sistolni krvni pritisak za 12,8 % ($p < 0,03$).

Kod pacijenata sa hiperlipidemijom bez koronarne bolesti srca i drugih faktora rizika za koronarnu bolest srca, postignute promene nivoa lipoproteina indikator su za dalju primenu nefarmakoloških mera sa ciljem smanjenja rizika za koronarne probleme. Određivanje profila lipoproteina i aterogenih markera veoma je značajno u inicijalnom pregledu dislipidemije, praćenju efekata fizičke aktivnosti i proceni rizika za koronarnu bolest srca.

Acta Medica Medianae 2019;58(2):27-32.

Ključne reči: *fizička aktivnost, hiperlipidemija, primarna prevencija*