Original Research Article

Hyperhomocysteinemia, lipid and lipoprotein disturbances in patients with primary hypertension

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ARTICLE INFO

ABSTRACT

Purposes: The main aim of the study was to answer two questions: what are the concentrations of total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, apo A-I (apolipoprotein A-I), apo B (apolipoprotein B) and Lp(a) (lipoprotein(a)) in serum of patients with primary hypertension and with hyperhomocysteinemia? Is there any correlation between the concentration of homocysteine in blood serum and investigated lipid and lipoprotein parameters in patients with primary hypertension?
Material/methods: We investigated 42 patients with primary hypertension, aged 22–57. The control group consisted of 20 healthy volunteers. The concentration of homocysteine in serum was evaluated using immunochemical method (FPIA – Fluorescence Polarization Immunoassay). The concentration of total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides in blood serum were estimated using enzymatic method. Apo A-I, apo B and lipoprotein(a) were assessed using nephelometric method.
Results: The analysis of the results revealed statistically significant lower concentrations of HDL-cholesterol and apo A-I in blood serum of patients with primary hypertension and hyperhomocysteinemia than in the population with hypertension and normohomocysteinemia. Negative correlation between homocysteine and HDL-cholesterol as well as apo A-I has been revealed.
Conclusion: Quantitative analysis of the concentration of lipids and lipoproteins in blood serum in patients with primary hypertension and hyperhomocysteinemia may suggest that this type of human population might be more susceptible to atherosclerosis than those with primary hypertension and normal values of homocysteine.

1. Introduction

Hypertension is one of the most common chronic diseases widespread all over the world. The number of people with hypertension has been estimated for over 1.5 billion [1]. Elevated blood pressure is also one of the most important causes of chronic heart failure and its complications. Due to its prevalence, contribution to other heart diseases and available ways of treatment, the effective therapy of hypertension is regarded as one of the most valid factors of primary and secondary prevention of chronic heart disease.

Epidemiological research allowed the identification of many risk factors that might contribute to the development of primary hypertension. They might be divided into modified and non-modified ones. Modified ones are: obesity and overweight, salty diet, lack of physical activity, smoking, alcohol abuse and hyperhomocysteinemia. Non-modified risk factors are genetic and ethnic factors, age and gender [2–4].

Hyperhomocysteinemia is a new risk factor of problematic classification. Its influence on blood vessels is still unknown and requires further investigation. Not every patient with chronic heart disease presents classic risk factors. That is why the assessment of the level of homocysteine may be helpful in the prediction of heart failure [4]. It has been proven that sole hyperhomocysteinemia, with no other risk factors, might be responsible for 10% of heart failures. Other 90% cases are bound with classic risk factors. It is known that coexistence of two or more risk factors increases their unfavorable mechanism [5,6]. It has been confirmed that hyperhomocysteinemia increases proatherogenic influence of hypertension and smoking [7–9]. A positive correlation between concentration of homocysteine in serum, lipids and lipoproteins

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was observed [10–12]. Among patients with primary hypertension, the coexistence of several risk factors might cause endothelium damage, accelerates the development of atherosclerosis and leads to ischemic heart disease and strokes [13].

The main purpose of the study was to answer two questions: what are the concentrations of total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, apo A-I (apolipoprotein A-I), apo B (apolipoprotein B) and Lp(a) (lipoprotein(a)) in serum of patients with primary hypertension and with hyperhomocysteinemia? The second question was whether there is any correlation between the concentration of homocysteine and investigated lipid and lipoproteins parameters in blood serum of patients with primary hypertension?

2. Material and methods

We investigated 42 patients with primary hypertension (21 males and 21 females), aged 22–57 ($x = 43.67$). Hypertension was recognized in patients with blood pressure higher than 140/90 mmHg. The examined patients did not suffer from any other cardiovascular diseases (coronary heart disease, peripheral vascular disease, cerebral stroke) or hypertensive complications. Patients suspected of suffering from kidney diseases, neoplastic diseases, hormonal disturbances, hepatocellular damage, diabetes, neurological diseases and psoriasis were excluded from the study.

The investigated population with primary hypertension was divided into two different subgroups, based on the concentration of homocysteine in serum. The cut-off level of homocysteine was 12 μmol/l. Patients with higher concentration of homocysteine in serum were classified to the group with hyperhomocysteinemia, the others were included into the group with normohomocysteinemia.

The control group consisted of 20 healthy volunteers (10 females and 10 males), aged 24–53 ($x = 44.85$), without hypertension or any heart disease. The clinical characteristic of both investigated groups is presented in Table 1.

Concentrations of homocysteine were determined by the immunochemistry method (FPIA) using AxSYM analyzer (Abbott, Abbott Park, USA). The reference values for this method are 5.0–12 μmol/l. Concentrations of total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides were determined by enzymatic method using the Dimension analyzer (Siemens, Munich, Germany). Concentrations of apo-protein A-I, apo-protein B, lipoprotein(a) were determined by the nephelometric method using Nephelometer Analyzer II (Siemens, Munich, Germany).

We used the Student's t-test and the nonparametric Mann–Whitney test to compare the concentrations of the parameters identified in the serum of patients with essential hypertension and in patients in the control group. We used the Pearson and Spearman tests to determine the correlation between homocysteine and total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, apo A-I, apo B, and Lp(a). All statistical hypotheses assumed statistical significance at $p < 0.05$. Statistical analysis of the results was performed using the computer program STATISTICA v. 9.0 (StatSoft, Poland).

3. Results

The concentration of homocysteine in serum was slightly higher in patients with primary hypertension than in the control group, however, it was not statistically significant. The concentration of homocysteine in serum of control group and two subgroups of patients with primary hypertension are presented in Table 1.

The highest levels of total cholesterol were observed in the hypertensives with hyperhomocysteinemia. However, this concentration was not statistically significant in comparison to levels of total cholesterol in population with primary hypertension with normohomocysteinemia and healthy ones (Table 2). Similar situation was observed in case of LDL-cholesterol concentration. The levels of HDL-cholesterol were statistically significantly lower in patients with primary hypertension and hyperhomocysteinemia than in population with hypertension with normohomocysteinemia or in control group (Table 2). At the same time, the levels of triglycerides were substantially elevated in investigated population with primary hypertension and hyperhomocysteinemia (Table 2).

The results revealed statistically significant lower concentrations of apo A-I in blood serum of patients with primary hypertension and hyperhomocysteinemia than in the population with hypertension and normohomocysteinemia or in control group. Furthermore, the highest levels of apo B were noticed in patients with hypertension and normal values of homocysteine (Table 3).

Statistically significant alterations were not observed in the concentration of lipoprotein(a) in serum. All groups: with primary hypertension and hyperhomocysteinemia, with primary hypertension and normohomocysteinemia and control group presented similar values of lipoprotein(a) in serum (Table 3).

In investigated populations, the negative correlation between homocysteine and HDL-cholesterol ($r = -0.5381$, $p = 0.0002$) as well as apo A-I ($r = -0.5141$, $p = 0.0051$) was observed.

Table 1
Comparison of control group with the study group of patients with primary hypertension.

Parameter	Control group $n = 20$	Patients with primary hypertension $n = 42$
Gender		
Female	10 (50%)	21 (50%)
Male	10 (50%)	21 (50%)
Age (years)		
Mean value ± SD	44.85 ± 7.41	43.69 ± 11.34
Median	44.00	47.50
X min–X max	24–53	22–57
Body mass index – BMI (kg/m²)		*
Mean value ± SD	25.10 ± 3.54	28.63 ± 5.57
Median	26.00	28.50
X min–X max	19.5–32.0	18.6–43.0
Waist/hip ratio – WHR (m)		
Mean value ± SD	0.85 ± 0.10	0.87 ± 0.09
Median	0.86	0.86
X min–X max	0.65–1.0	0.7–1.1
Systolic blood pressure (mmHg)		*
Mean value ± SD	119.65 ± 13.08	153.14 ± 16.79
Median	125.00	150.00
X min–X max	92–135	122–220
Diastolic blood pressure (mmHg)		*
Mean value ± SD	80.00 ± 8.17	97.10 ± 8.79
Median	80.00	100.00
X min–X max	64–90	78–115
Heart rate		
Mean value ± SD	76.10 ± 13.63	74.13 ± 8.42
Median	72.00	74.00
X min–X max	52–106	60–94
Homocysteine (μmol/l)		
Mean value ± SD	10.07 ± 1.89	10.68 ± 3.16
Median	9.57	9.78
X min–X max	6.72–13.84	6.27–19.72
Concentration ≤12 μmol/l	$n = 16$ (80.0%)	$n = 27$ (64.3%)
Concentration >12 μmol/l	$n = 4$ (20.0%)	$n = 15$ (35.7%)

* Statistically significant difference in comparison to the control group, $p < 0.05$.