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**STATUS OF LIPID METABOLISM PARAMETERS, INTIMA-MEDIA COMPLEX THICKNESS, AND PERSONAL ANXIETY IN YOUNG PEOPLE WITH ARTERIAL HYPERTENSION AND OVERWEIGHT**

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The purpose of the study was to establish the relationship between lipid metabolism parameters, the condition of the vascular wall of the common carotid artery, and personal anxiety in young overweight patients with arterial hypertension. 76 patients (mean age  $41.5 \pm 3.1$  years) with grade 1–2 arterial hypertension who did not receive systematic drug therapy were examined, of which 45 had a normal body mass index (group 1) and 31 were overweight (group 2). All patients who did not receive systematic drug therapy showed a decrease in the level of psychological health, which was determined by high and moderate levels of reactive and personal anxiety. It was found that in patients with excess body weight, high levels of reactive and personal anxiety were determined in 58 % and moderate levels in 42 %. At the same time, in patients with normal body weight, an increase in the levels of reactive and personal anxiety to moderate was noted only in 33.3 %. Dyslipidemia was detected in 20 % of patients in group 1 and 51.6 % of group 2. Probable differences in lipid metabolism indicators were identified in patients with grade 1–2 arterial hypertension and increased body weight: an increase in total cholesterol, triglycerides, low-density lipoprotein cholesterol and a decrease in high-density lipoprotein cholesterol. It was demonstrated that in patients aged 25–44 years with arterial hypertension of 1–2 degrees, there was an increase in the content of C-reactive protein in the blood serum, but significant differences were found in patients with increased body weight. Also, in young people with arterial hypertension of 1–2 degrees, criteria for carotid artery remodeling were determined, according to the assessment of the thickness of the intima-media complex, which were significantly more pronounced in overweight individuals compared to the control group.

**Key words:** arterial hypertension in young people, psychoemotional disorders, excess body weight, lipid metabolism, C-reactive protein, intima-media complex.

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**СТАН ПОКАЗНИКІВ ЛІПІДНОГО ОБМІНУ, ТОВЩИНИ КОМПЛЕКСУ ІНТИМА-МЕДІА ТА ОСОБИСТІСНОЇ ТРИВОЖНОСТІ В ОСІБ МОЛОДОГО ВІКУ З АРТЕРІАЛЬНОЮ ГІПЕРТЕНЗІЄЮ ТА НАДЛИШКОВОЮ МАСОЮ ТІЛА**

Метою дослідження було вивчити взаємозв'язок параметрів ліпідного обміну, стану судинної стінки загальної сонної артерії та особистісної тривожності у пацієнтів з артеріальною гіпертензією молодого віку з надлишковою масою тіла. Обстежено 76 пацієнтів (середній вік  $41,5 \pm 3,1$  роки) з артеріальною гіпертензією 1–2 ступеня, які не отримували систематично медикаментозну терапію, з яких 45 – з нормальним індексом маси тіла (1 група) та 31 – з надлишковою масою тіла (2 група). Встановлено, що у хворих з артеріальною гіпертензією 1–2 ступеня молодого віку, які не отримували систематично медикаментозної терапії, виявлено зниження рівня психологічного здоров'я, що виражалось у збільшенні числа осіб з високим і помірним рівнем реактивної і особистісної тривожності. Встановлено, що у пацієнтів з надмірною масою тіла у 58 % визначаються високі та у 42 % помірні рівні реактивної і особистісної тривожності. При цьому у пацієнтів з нормальною масою тіла збільшення рівнів реактивної і особистісної тривожності до помірного відмічено лише у 33,3 %. Дисліпідемія виявлена у 20 % пацієнтів 1 групи та 51,6 % 2 групи. Достовірні відмінності показників ліпідного обміну визначено у пацієнтів з артеріальною гіпертензією 1–2 ступеня та підвищеною масою тіла, які не отримують систематичної медикаментозної терапії: збільшення вмісту загального холестерину, тригліцеридів, холестерину ліпопротеїнів низької щільності та зменшення холестерину ліпопротеїнів високої щільності. Продемонстровано, що у пацієнтів 25–44 років з артеріальною гіпертензією 1–2 ступеня, які не отримують систематичної медикаментозної терапії, відмічено підвищення вмісту С-реактивного протеїну в сироватці крові, але достовірні відмінності встановлено у хворих з підвищеною масою тіла. Виявлено, що у молодих людей з артеріальною гіпертензією 1–2 ступеня, які не отримували систематично медикаментозної терапії, визначаються критерії ремоделювання сонних артерій, за даними оцінки товщини комплексу інтима-медіа, достовірно більш виражені в осіб з надлишковою вагою в порівнянні з групою контролю.

**Ключові слова:** артеріальна гіпертензія в осіб молодого віку, психоемоційні порушення, надлишкова маса тіла, ліпідний обмін, С-реактивний протеїн, комплекс інтима-медіа.

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Arterial hypertension (AH) is the main modifiable risk factor for the development of vascular atherosclerosis in the world [5]. Uncontrolled blood pressure (BP) contributes to the development of myocardial infarction, stroke, atrial fibrillation, heart

failure and sudden cardiac death, as well as chronic kidney disease, dementia, etc. [6].

According to studies conducted in the United States over the past decades, the mortality rate from cardiovascular diseases has increased significantly in

middle-aged and older age groups, which is less pronounced in young people. Such changes are believed to be associated with the increasing prevalence of hypertension in young adults and lower awareness of both the disease and its consequences in later life [14].

In addition to hypertension, dyslipidemia is a major risk factor for cardiovascular disease, which often coexists. Research has shown that the atherosclerotic process is an inflammatory disease involving proinflammatory cytokines, and inflammation appears to play an important role in the pathophysiology of atherosclerosis [9].

A meta-analysis [11] of 20 prospective studies that recorded baseline common carotid intima-media thickness and carotid plaque events in 21 494 individuals with no history of cardiovascular disease and no pre-existing carotid plaque at baseline showed that increased common carotid intima-media thickness was associated with a long-term risk of developing a first carotid atherosclerotic plaque, independent of traditional cardiovascular risk factors.

Research suggests that the burden of mental disorders in young people has been increasing over the past decade [12]. Anxiety and depression have been reported to be more common in patients with hypertension, but their prevalence in young people with hypertension is poorly understood. In addition, there is a lack of clinical data on the effects of anxiety disorders on lipid metabolism and carotid wall function.

**The purpose** of the study was to examine the relationship between lipid metabolism parameters, the condition of the vascular wall of the common carotid artery, and personal anxiety in young, overweight patients with arterial hypertension.

**Materials and methods.** 76 patients aged 25 to 44 years (mean age  $41.5 \pm 3.1$  years) with grade 1–2 hypertension who did not receive systematic drug therapy were examined; of them 24 men and 52 women. Depending on the body mass index, 2 groups were distinguished: 1st – 45 patients with a normal body mass index (body mass index  $24.5 \pm 0.5$  kg/m<sup>2</sup>) and 2nd – 31 patients with excess body weight (body mass index  $28.9 \pm 0.6$  kg/m<sup>2</sup>).

The control group included 20 practically healthy individuals (9 men and 11 women, mean age  $40.7 \pm 3.3$  years) with normal blood pressure and body weight (body mass index  $24.1 \pm 0.6$  kg/m<sup>2</sup>).

Exclusion criteria: history of taking antihypertensive drugs less than 3 months before inclusion in the study, professional athletes, secondary hypertension, heart rhythm disorders, inflammatory diseases, autoimmune and endocrine diseases.

The criterion for overweight was a body mass index  $\geq 25$  kg/m<sup>2</sup>, the criterion for obesity was a body mass index  $\geq 30$  kg/m<sup>2</sup>, and abdominal obesity was a waist circumference in women of more than 80 cm.

The C.D. Spielberger anxiety questionnaire, containing 40 questions, was used to assess situational and personal anxiety. The result was evaluated as follows: up to 30 – low anxiety, 31–45 – moderate anxiety, 46 and more – high anxiety.

All subjects underwent a general clinical examination, which included a questionnaire to identify risk factors for cardiovascular diseases, examination, anthropometric measurements, a medical physical examination, including office blood pressure (BP) measurement, a complete blood count and urine analysis (with determination of microalbuminuria by test strip), a biochemical blood test with determination of fasting glucose, creatinine (with calculation of GFR according to the CKD-EPI formula),

Serum lipid metabolism parameters (concentration of total cholesterol (TC), high-density lipoproteins (HDL-C), triglycerides (TG) were determined by enzymatic colorimetric method using “Human” kits (Germany). The cholesterol content in low-density lipoproteins (LDL-C) was determined according to the Friedewald W.T. formula:  $LDL-C$  (mmol/l) =  $TC - (HDL-C + TG/2.22)$ . The atherogenic coefficient (CA) was calculated according to the formula:  $CA = (TC - HDL-C) / LDL-C$ . ECG parameters were determined in 12 standard leads on the ECG600G device (“Heaco ltd”, Great Britain).

Enzyme immunoassay was used to determine the concentration of C-reactive protein (CRP) using diagnostic kits from DRG (USA). The studies were performed on an enzyme immunoassay analyzer LabLine-90 (Austria).

Ultrasound examination of the brachiocephalic arteries was performed on an ultrasound diagnostic scanner “LOGIQ 5” («Medical System», Germany), with a 7 MHz linear sensor and an Ultima PA scanner (RADMYR, Ukraine) with a 5–12 MHz linear sensor. The common carotid artery (CCA) was examined in a standard projection. The diameter was assessed at rest (after a 10-minute rest).

According to the Consensus of the American Society of Echocardiography, measurements of the thickness of the IMC of the CCA were performed, and an individual approach was used to determine normal values, taking into account gender and age: the threshold value of IMC for men under 40 years of age was 0.7 mm, 40–50 years of age – 0.8 mm, over 50 years of age – 0.9 mm, for women under 45 years of age – 0.7 mm, 45–60 years of age – 0.8 mm, over 60 years of age – 0.9 mm. When atherosclerotic plaques were detected, their qualitative and quantitative assessment was performed.

The study was conducted at the Government Institution “L.T. Malaya Therapy National Institute of the National Academy of Medical Sciences of Ukraine”. All subjects signed an informed consent to participate in the study. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Statistical processing of the research results was carried out using the STATISTICA 10.0 program and a package of application programs. The arithmetic means of the studied values, standard deviations, and representativeness errors were calculated. To identify the relationship between the studied values, Spearman correlation analysis was used. The difference in indicators in the groups was assessed using the Mann-Whitney test and the Student test. The significance level  $p$  was taken to be less than 0.05.

**Results of the study.** In young people with stage 1–2 hypertension with normal body weight who do not receive systematic drug therapy, anxiety levels were distributed as follows: 30 people had low levels and 15 had moderate levels and, overall, did not differ significantly from the control group. Table 1 presents the results of the analysis of the psycho-emotional state among the surveyed young people.

Table 1

**Parameters of reactive and personal anxiety in patients with hypertension and overweight (M ± m)**

Parameters	Control group (n=20)	Group 1 (n=45)	Group 2 (n=31)
Reactive anxiety	29.7±3.5	31.9±3.7	49.5±5.1* <sup>1</sup> ** <sup>2</sup>
Personal anxiety	28.9±3.3	37.3±3.5	57.4±6.3* <sup>1</sup> ** <sup>2</sup>

Notes: \*<sup>1</sup> – probability when comparing between groups 1 and 2; \*\*<sup>2</sup> – probability when comparing with the control group.

The obtained data showed that in patients with hypertension of 1–2 degrees with increased weight, anxiety levels among men and women corresponded to high in 58 % and moderate in 42 %. Moreover, both reactive and personal anxiety were significantly higher compared to the control group ( $p < 0.001$ ).

Analysis of blood lipid spectrum indicators showed that dyslipidemia was detected in 9 (20 %) patients in group 1 and 16 (51.6 %) in group 2. Lipid metabolism indicators in patients in group 1 did not significantly differ from the data of the control group.

Lipid metabolism parameters in patients of group 1 did not significantly differ from those of the control group. However, analysis of blood lipid spectrum parameters showed that dyslipidemia was detected in 9 (20 %) patients of group 1 and 16 (51.6 %) of group 2.

The levels of LDL-C in patients with hypertension of grades 1–2 with increased body weight increased by 32.9 % and 21.5 % compared with the data of the control group and patients of group 1, respectively (all  $p < 0.05$ ). Similar changes were observed for TG, the concentration of which in

patients with hypertension of grades 1–2 with increased body weight was significantly higher by 25.3 % and 13.9 %, respectively, in the control group and patients of group 1 (all  $p < 0.05$ ). The concentration of LDL-C in group 2 increased by 35.5 % and 23.6 %, respectively, in the control group and patients of group 1 (all  $p < 0.05$ ). A decrease in HDL-C levels was observed by 22.9 % and 10.7 % compared with the control group and data of patients with hypertension of grades 1–2 with normal body weight (all  $p < 0.05$ ).

In our study, it was noted that the concentration of CRP in the blood serum increased in patients with grade 1–2 hypertension of both groups, but significant differences were found only for individuals with increased body weight compared to the control group. The results of the CRP study in the blood of the examined individuals are presented in Fig. 1.

The results obtained regarding the thickness of the IMC of the CCA in the examined young individuals who do not receive systematic drug therapy are presented in Fig. 2.

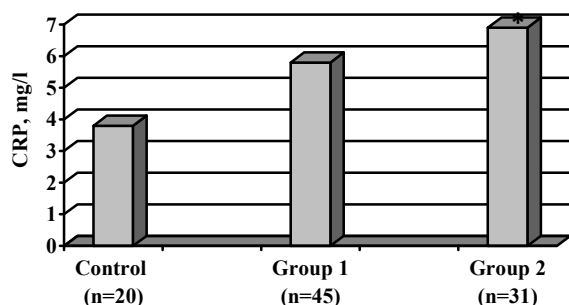


Fig. 1. CRP content in the blood of the examined individuals. Note. \* – probability of differences with the control group ( $p < 0.05$ ).

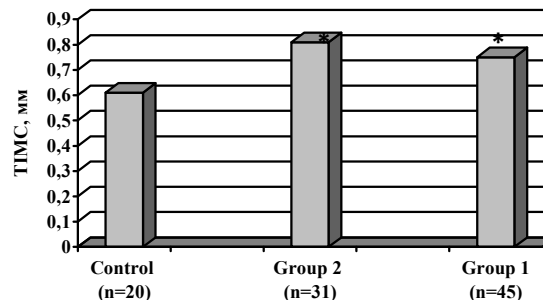


Fig. 2. Thickness of the IMC (TIMC) of the CCA in the examined young people. Note. \* – significant differences with the control group ( $p < 0.05$ ).

Analysis of the thickness of the CIM of the carotid artery in patients of groups 1 and 2 significantly ( $p < 0.05$ ) exceeded the data of patients of the control group by 22.9 % and 32.8 %, respectively. Comparison of the results of the thickness of the CIM of the carotid artery in patients with hypertension of

1 and 2 degrees depending on body weight allowed us to establish that this indicator increased in patients with increased body weight ( $\Delta 0.06$  mm,  $p < 0.05$ ).

The obtained data indicate that in young patients with a stable and prolonged increase in blood pressure, signs of structural and functional changes in

the carotid arteries in the form of an increase in CIM are noted, more pronounced in the group with hypertension of 1–2 degrees with increased body weight.

**Discussion.** The relationship between anxiety and hypertension is complex [2]. Dopamine and related neurotransmitters are known to have antihypertensive effects, and its deficiency in certain brain regions contributes to increased BP and depression [7]. The association between anxiety and an increased risk of hypertension is well established [10]. There is limited evidence regarding the relationship between body mass index and anxiety symptoms in young people with hypertension. In our study, anxiety disorders in young people with stage 1–2 hypertension were recorded in patients with increased body weight.

In a study conducted by Kandasamy G. et al. [6], a significant correlation was established between anxiety and obesity in people with hypertension. In addition, obesity is associated with an increased risk of depression, metabolic disorders, anxiety, cardiovascular diseases and chronic inflammatory conditions. A Japanese study [13] showed that in young people, changes in body weight have a significant effect on blood pressure.

Hypertension and dyslipidemia are major risk factors for cardiovascular disease, which often coexist. The results of our study suggest that in young patients with hypertension, the presence of increased body weight is accompanied by a higher prevalence of atherogenic dyslipidemia.

The atherosclerotic process underlying CVD begins in early childhood, and its progression depends on the presence of identified risk factors for the disease [9]. Less is known about the patterns of CVD development at a young age, including its progression and the development of complications later in life.

Over the past decade, the atherosclerotic process has been defined as an inflammatory disease involving altered levels of proinflammatory

cytokines, and inflammation is likely to play a critical role in the pathophysiology of atherosclerosis [4]. Another study has shown that in hypertension, myocardial infarction, diabetes mellitus, and sleep apnea, elevated C-reactive protein levels are attributable to the increased adipose tissue mass commonly seen in these diseases. However, in other diseases, systemic inflammation cannot be explained solely by excess adipose tissue mass [1].

Early identification of individuals at risk of future cardiovascular events is of vital importance, as early correction of new risk factors is more effective than therapy of advanced atherosclerotic vascular disease [8].

Noninvasive measurement of structural changes in straight artery segments, such as carotid intima-media thickness, is a well-established surrogate marker of early subclinical atherosclerosis. It helps identify individuals at risk for future clinical endpoints, including coronary and cerebrovascular events, earlier than established risk factors.

Studies conducted in young people using noninvasive ultrasound methods have shown a strong correlation between abnormalities of vascular structure and function and all classic risk factors for cardiovascular disease [3, 15]. It has been established that the thickness of the intima-media of the common carotid artery is associated with the long-term risk of developing the first carotid plaque in history, regardless of traditional cardiovascular risk factors [11]. Our data showed that with increasing body weight in young patients with AH 1–2 stages, there was a significant increase in the thickness of the intima-media of the common carotid artery compared with patients with normal body weight.

It would be interesting to expand the study cohort of young patients with stage 1–2 hypertension and overweight and to further investigate the impact of lifestyle factors (dietary habits, physical activity, and the presence of insomnia) on the condition of the common carotid artery wall.

## Conclusion

In patients with AH 1–2 degrees of young age, who did not receive systematic drug therapy, a decrease in the level of psychological health was found, which was expressed in an increase in the number of people with high and moderate levels of reactive and personal anxiety. It was found that in patients with excess body weight, high levels of reactive and personal anxiety were determined in 58 % and moderate levels in 42 %. At the same time, in patients with normal body weight, an increase in the levels of reactive and personal anxiety to moderate was noted only in 33.3 %.

It was established that dyslipidemia was detected in 20 % of patients in group 1 and 51.6 % in group 2. In patients with grade 1–2 hypertension and increased body weight, significant differences in lipid metabolism indicators were identified: an increase in total cholesterol, triglycerides, low-density lipoprotein cholesterol and a decrease in high-density lipoprotein cholesterol.

In patients aged 25–44 years with hypertension of the 1st and 2nd degree who did not receive systematic drug therapy, an increase in the content of PSA in the blood serum was noted, but significant differences were observed in patients with increased body weight.

In young people with grade 1–2 hypertension who did not receive systematic drug therapy, criteria for carotid artery remodeling were determined, according to the assessment of ICM thickness, which were probably more pronounced in overweight individuals compared to the control group.

*Prospects for further research. We believe that it would be worthwhile to investigate the effects of correcting lipid metabolism parameters, anxiety disorders, and body weight on the state of the common carotid artery wall during long-term follow-up.*

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