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VEGETATIVE SYMPTOMS AND ARTERIAL STIFFNESS IN PATIENTS WITH HYPERTENSION-ASSOCIATED CEREBROVASCULAR DYSFUNCTION DEPENDING ON PLASMA TOTAL CHOLESTEROL

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ABSTRACT — 129 general practice patients with stages II and III arterial hypertension (AH) were enrolled in a study aimed to assess the severity of cerebral disorders, rigidity of the vascular wall and the manifestation of vegetative symptoms. It was found that in AH patients with hypercholesterolemia, the manifestations of cerebrovascular dysfunction intensified. There were significant changes in the elastic properties of the vascular wall accompanied by vegetative symptoms, which should be taken into account when designing an individual treatment plan.

KEYWORDS — arterial hypertension, vascular wall stiffness, cerebrovascular disorders, vegetative symptoms.

INTRODUCTION

A special in its importance place among cerebrovascular diseases is occupied by chronic cerebral ischemia, developing as a result of slowly progressive cerebral circulation insufficiency most often against the background of atherosclerosis, arterial hypertension or their combinations [1–5]. The importance of solving problems of early diagnosis, prevention and therapy of chronic cerebral ischemia is due to the high prevalence of the disease among the population, and its importance as a risk factor for stroke [6]. Not only neurological, cognitive, but also vegetative disorders are present in the clinical picture of chronic cerebral ischemia. A close relationship between cerebrovascular pathology and functioning of vegetative nervous system is known [7, 8]. At the same time, the peculiarities of vegetative regulation of cardiac rhythm and its relationship with cerebral hemodynamics in patients with chronic cerebral ischemia with hypercholesterolemia are not sufficiently studied.

MATERIALS AND METHODS

129 patients (men — 34, women — 95; mean age $55, 2 \pm 11.3$ years) of stage II and III AH, which were on dispensary observation with a general practitioner and received combined hypotensive therapy. In accordance with the GFCF National Clinical Recommendations for the diagnosis and correction of lipid metabolism disorders (2017), patients were divided into 2 groups depending on the level of total cholesterol in blood plasma: the 1st (control) group comprised 68 patients with optimal ($< 5,0$; $4,3 \pm 0,5$ mmol/l) level; 2–61 patients with increased ($\geq 5,0$; $6,1 \pm 0,9$ mmol/l) blood plasma total cholesterol level.

The criteria of exclusion were: symptomatic AH, signs of heart failure, endocrine, infectious, mental diseases. At the time of the study, all subjects received routine hypotensive therapy (calcium channel blockers, angiotensin-converting enzyme inhibitors) according to the severity of the disease.

All patients were subjected to a clinical examination, and the neurological status of the patients was assessed. An A.M. Vane questionnaire was used to detect vegetative dystonia syndrome (SVD), which was filled in by patients. In the mathematical processing of the results of the questionnaire, the total sum of points obtained from the evaluation of the questionnaire should not exceed 15 points in healthy people, whereas in case of excess it is possible to talk about the presence of SVD.

The vegetative tone was evaluated by the Kerdo index (IR) as follows: $IR = (1 - ADD/HR) \cdot 100\%$, where ADD is diastolic AD blood in mm Hg. HR — frequency of total reductions per 1 minute. At full vegetative weight (eitonía), the Kerdo index is zero; If the coefficient was negative, the sympathetic tone dominated; parasympathetic tone is increased in case of high coefficient.

The rigidity of the vascular wall was studied by photoplethysmographic method using the apparatus *Angioskan-01 Professional* (Russia) in the morning hours in a quiet and darkened room, strictly fasting; before the procedure, patients did not smoke or consume tea, coffee. The following indicators were

calculated on the basis of the planimetric analysis of a pulse wave: the index of rigidity (SI, m/s), the index of augmentation (Alp 75, %) normalized for pulse rate (beats/min ChP=75), the index of reflection (RI, %). For assessment of endothelial dysfunction carried out test with jet hyperaemia with definition of the index of occlusion on amplitude (IOA, conv. units) and shift of phases (SF, ms) between channels [1]. The obtained data were accumulated in Table Excel 2003, and statistical processing was carried out using the statistical package Statistica 10. The normality of the sample distribution was determined by the Kolmogorsk-Smirnov criterion. The arithmetic mean of the standard deviation ($M \pm SD$) was calculated in the data processing for quantitative characteristics. The difference between the fractions was estimated using the χ^2 criterion in the 2×2 conjugation tables, Fisher's exact criterion. Comparison of the two groups on quantitative scales was based on the non-parametric Mann-Whitney. Correlation analysis was performed using the Pearson linear correlation coefficient to determine the dependencies between the parameters studied. The level of statistical significance was recorded at 0.05.

RESULTS

in patients of the 1st group, the level of blood pressure was $134,2 \pm 13,6 / 83,5 \pm 10,6$ mm Hg.st.; the level of total plasma cholesterol is $4,3 \pm 0,5$ mmol/l. The initial manifestations of cerebrovascular insufficiency were recorded in 22 (32,4%), chronic cerebral ischemia I and II stages — in 46 (67,6%). When assessing the clinical signs of cerebral disorders, dizziness was detected in 43 (63,2%), headache in 54 (79,4%), noise and tinnitus in 35 (51,5%), decreased memory and attention in 51 (75,0%), sleep disturbance — in 45 (66,2%), increased fatigue — in 45 (66,2%) patients. When assessing the neurological status, there were irregularities in the performance of coordination tests (Romberg test, finger test) in 46 (67,6%) patients.

During the contour analysis of the pulse wave, an increase in RI ($38,2 \pm 15,1\%$) was observed, which indicated an increase in the tone of small resistance vessels, the SI level was $7,9 \pm 0,1$ m/s, Alp 75 ($10,3 \pm 15,3\%$). When conducting an occlusion test, IOA — $1,9 \pm 0,7$ conv. units, SF — minus $6,6 \pm 4,6$ ms, which indicated the presence of endothelial dysfunction.

Hyperventilation syndrome was detected in 26 (38,2%), thermoregulatory syndrome in 36 (52,9%), neurogastric syndrome in 37 (54,4%), sweating disorders in 45 (66,2%), asthenic in 31 (45,6%), cardiovascular — in 34 (50,0%) patients. The Kerdo index was minus $17,9 \pm 20,6$ points. According to the Wayne scale, 50 (73,5%) of the examined had signs of autonomic dystonia ($28,2 \pm 13,9$ points).

When conducting a correlation analysis in the absence of hypercholesteinemia, there was a statistically significant inverse correlation between a very weak force between the level of total blood plasma cholesterol and IOA $r = -0,252$ ($p < 0,01$), and the total score on the Wayne scale $r = -0,272$ ($p < 0,01$); very weak strength between the Kerdo index and Alp 75 $r = -0,245$ ($p < 0,01$), weak strength between the Kerdo index and IOA $r = -0,348$ ($p < 0,01$).

In patients of group 2, the level of blood pressure was $138,9 \pm 17,6 / 82,1 \pm 9,9$ mm Hg. st.; the level of total plasma cholesterol was $6,1 \pm 0,9$ mmol/l. The initial manifestations of cerebral insufficiency were recorded in 6 (13,1%), chronic cerebral ischemia stage I and stage II - in 53 (86,9%; $p < 0,01$, test χ^2). An increase in cerebral complaints was noted. So, headache was detected in 50 (82,0%), noise and tinnitus in 46 (75,4%; $p < 0,005$, test χ^2), reduced memory and attention in 52 (85,2%), dizziness — in 40 (65,6%), increased fatigue - in 46 (75,4%), sleep disturbance — in 48 (78,7%) patients. According to a neurological examination, impaired coordination tests (Romberg test, finger test) were found in 53 (86,9%; $p < 0,010$, test χ^2) patients.

When conducting a contour analysis of the pulse wave in patients of this group, an increase in Alp 75 ($19,7 \pm 11,8\%$, $p < 0,0001$), RI ($47,3 \pm 19,6\%$, $p < 0,007$) was observed, indicating a more pronounced violation of the elastic properties of the vascular wall; SI level was $7,9 \pm 0,7$ m/s. During an occlusal test, a decrease in IOA ($1,7 \pm 0,5$ conv. units) and SF (minus $5,5 \pm 6,1$ ms, $p < 0,040$) was recorded, which indicated a more pronounced endothelial dysfunction.

Hyperventilation syndrome was detected in 32 (52,5%; $p < 0,010$, test χ^2), thermoregulatory syndrome — in 35 (57,4%), neurogastric — in 34 (55,7%), asthenic — in 38 (62,3%; $p < 0,029$, test χ^2), cardiovascular syndrome — in 31 (50,8%), sweating disorders — in 40 (65,6%) patients. The Kerdo index was minus $18,6 \pm 23,1$ points. According to the Wayne scale, there were signs of autonomic dystonia ($33,5 \pm 13,9$ points, $p < 0,034$) in 48 (78,7%) examined.

When conducting a correlation analysis for hypercholesteinemia, there was a statistically significant direct correlation between the weak strength between total blood plasma cholesterol and Alp 75 $r = 0,351$ ($p < 0,01$), and RI $r = 0,303$ ($p < 0,05$); weak strength between the Kerdo index and Alp 75 $r = -0,315$ ($p < 0,01$).

DISCUSSION

In the examined AH patients with hypercholesterolemia, cerebrovascular disorders in the form of stage I and II chronic cerebral ischemia are more common, which are combined with increased rigidity

of the vascular wall and pronounced endothelial dysfunction. The frequency of vegetative disorders with the prevalence of parasympathetic tone among AH patients is registered equally regardless of the level of total cholesterol of blood plasma, while the expression of vegetative symptoms increases in the progression of cerebrovascular disorders. In patients with hypercholesterolemia, a direct correlation between blood plasma total cholesterol level and Alp 75, and RI, the Kerdo index and Alp 75 was revealed.

CONCLUSIONS

The combination of arterial hypertension with hypercholesterolemia is characterized by the presence of pronounced cerebrovascular disorders, significant disorders of the elastic properties of the vascular wall and endothelial dysfunction accompanied by vegetative disorders. This challenge should be considered when developing individualized plans for treatment and rehabilitation.

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