

# Hypertensive encephalopathy. Clinical characteristics, diagnostic criteria

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## ABSTRACT

**Introduction.** Hypertension (HT) is a significant and independent risk factor for the development of cerebrovascular disease, which is a leading cause of death and disability and is one of the most common cardiovascular diseases in most countries of the world. In Ukraine, the percentage of patients with arterial hypertension is between 30 and 41%, which is more than 12 million patients.

**The aim** of our research - to improve the diagnostic approaches of cerebrovascular disorders in patients with hypertensive encephalopathy (HE) by clarifying the development of pathogenetic mechanisms, based on a comprehensive clinical and paraclinical study.

**Materials and methods.** Clinical and neurological examination; neuropsychological examination; instrumental examination (chronobiotic structure of blood pressure (BP) according to daily blood pressure monitoring; heart rate variability (HRV); single photon emission computed tomography (SPECT); laboratory testing (determining homocysteine levels).

**Results.** The normal level of homocysteine (GC) has been registered among 64.7% of patients with HE, moderate increase of GC has been noticed in 5.9% of cases, and a significant degree of increasment – only among 2.9% of patients. The spectral analysis of HRV has shown a decrease in the values of indicators of the overall variability of the heart rate, accompanied by a weakening of the parasympathetic and increased sympathetic effects on the cardiovascular system.

**Conclusions.** It has been established that vascular lesions of the retina, signs of left ventricular hypertrophy and hypercholesterolemia were more commonly observed among patients with HE II stage than among patients HE stage I. According to the results of daily blood pressure monitoring, changes in the parameters among patients with HE I stage, were characterized by an increase in pulse pressure (especially at night) in conjunction with an increase in the rate of morning blood pressure. High pulse pressure is accompanied by a decrease of brain perfusion (according to the SPECT) and this is an independent risk factor for the development of HE.

**Keywords:** hypertensive encephalopathy, homocysteine, hypertension, brain perfusion

## INTRODUCTION

According to the official statistics of the Ministry of Health of Ukraine, in 2015, there were 2,551,654 patients with various forms of cerebrovascular disease (CVD), which is about 7,200.3 cases per 100,000 population, and mortality from CVD was 186.6 per 100,000 population. These data suggest that in 2015, 79,775 Ukrainian citizens died of various forms of cerebrovascular disease [1]. The Atherosclerosis Risk in Communities Study (ARIC) has shown that 25% of all cardiovas-

cular events (coronary heart disease, coronary revascularization, stroke, and heart failure) were associated with hypertension [2,3,4].

The role of hypertension in damaging of the target organs has long been discovered, the frequency its complications is significant and is associated not only with high parameters of blood pressure [5,6]. There is a direct continuous connection between the indicator of blood pressure and the risk of cardiovascular disease: with the higher the systolic and / or diastolic blood pressure, the risk of stroke and myocardial infarction is higher [7,8,9]. The signifi-

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cance of hypertension in the formation of acute and chronic vascular cerebral insufficiency is undoubtedly closely related to such risk factors as increased body mass index, hypertriglyceridemia, hypercholesterolemia, smoking [10,11,12,13,14]. HT leads to the development of endothelial dysfunction [15,16], oxidative stress, disorders in the system of hemostasis with a tendency to hypercoagulation and thrombosis [17,18].

An increase of homocysteinemia level (GC), which contributes to the first manifestation and progression of hypertensive encephalopathy, except for dyslipidemia, smoking and arterial hypertension is an independent factor in vascular risk is [19].

HE among patients with hypertension is one of the most discussed neurological problems for the discussion. The study of the features that cause the development of hypertensive encephalopathy among HT patients, particularly in the early stages of the disease, has a scientific and practical significance. Therefore, it is a promising solution for the development of substantiated recommendations for the diagnosis of hypertensive encephalopathy in HT.

The aim. Improvement of the diagnostic approaches for cerebrovascular disorders among patients with hypertensive encephalopathy (HE) by clarifying the development of pathogenetic mechanisms, based on a comprehensive clinical and para-clinical study.

## MATERIALS AND METHODS

A total number of 351 patients (150 males, 201 females) with HE and HT 2-degree were examined during a clinical neurological study; neuropsychological examination: Mini-Mental State Examination (MMSE), Multidimensional Personality Questionnaire (MPQ), Beck Depression Inventory (BDI), The Spielberger State-Trait Anxiety Inventory (STAI); instrumental examination (chronobiological structure of the blood pressure (BP)) according to the daily blood pressure monitoring; the state of vegetative provision according to the heart rate variability (HRV); single photon emission computed tomography (SPECT); laboratory testing (determination of homocysteine level by immunoassay analysis); statistical methods of processing

results. The study did not include patients with secondary hypertension, diabetes mellitus, cardiac arrhythmias and cardiac insufficiency, stroke and myocardial infarction.

## RESULTS

The average age in the group was  $50.7 + 11.5$  years, duration of HT -  $9.44 + 5.64$  years. According to the classification of the vascular diseases of the brain and spinal cord, the patients correspond to the category of ICD-10-CM – hypertensive encephalopathy (I 67.4). Depending on the stage of encephalopathy, they were divided into two groups: the first group – 100 patients with HE stage I; The second group – 251 patients with HE stage II (51 patients - subgroup mixed encephalopathy). Patients with HE have a fairly high frequency of overweight (BMI  $29.02 \pm 2.15$  kg/m<sup>2</sup>) and abdominal obesity (57%), mainly caused by a low level of physical activity (44%). The mentioned risk-factors of the cardiovascular complications were observed more often among females. Males were characterized by heredity (32%) and smoking (24%). It was found that smoking was an independent risk factor for the development of HE ( $r = 0.542$ ). The control group included 90 patients (45 males and 45 females) with normal blood pressure, the average age was  $49.86 + 10.14$  years. A detailed analysis of the risk factors that the examined patients had, depending on the stage of HE, showed that the excess body weight was the same frequency as among patients with HE stages I and stages II. Remarkably, that hypercholesterolemia was registered more often at HE II stage, than at the HE stage I (51% and 42.9% respectively).

Considerably, that 154 (44%) patients complained about general malaise, 312 (89%) patients had headache, 224 (64%) had dizziness. Moreover, 196 (56%) patients were disturbed by ringing in the ears, heartache was noted by 210 (60%), palpitation – by 143 (41%) patients. Violations of the psychoemotional sphere among the examined patients were represented by complaints of predominantly anxiety-depressive nature, and for the cognitive sphere – in the form of complaints of weakening memory, reducing concentration and attention. Depressed mood was noted among 245 (70%) patients, appetite disturbance among 154 (44%), sleep

disorders among 273 (78%), anxiety among 182 (52%) and memory loss among 235 (67%).

There was determined polymorphism of manifestations during the study of clinical and neurological features among patients with HE II stage, which has been increasing with the progression of the disease. The severe cephalgia of the polymorphic nature in 91.5% of cases was associated with non-systemic dizziness combined with unstable walking (67%), nausea (68%) and vasomotor disorders (80%). Cardialgias were observed among 80% of patients, palpitation in 89% cases. During HE stage II, cognitive impairment (74.1%) was detected with a deficit of verbal memory (61.1%), sleep disorder (90%). Neurological syndromes prevailed over subjective symptoms. Patients with HE stage II, had following neurological syndromes: vestibular atactic syndrome (84%), pyramidal syndrome (76.5%), early sensory disorder (80%), mild cognitive impairment (94.5%) with weakened memory for current events and a decrease in professional employment capability. There was also a noted increase in the frequency of normotensive hydrocephalus (45.5%) compared with patients with HE stage I (25%). Vegetative symptoms were presented as permanent disorders and paroxysmal attacks. Vegetative-vascular paroxysms were detected in 52% of cases, of which sympathoadrenal paroxysms were in 30%, mixed – in 22%. The study of the disease among patients with HE stage II in the subgroup with mixed (atherosclerotic and hypertensive) encephalopathy showed an undulating, dynamic progression of clinical symptoms.

At the early stages of the disease, when the symptoms of the nervous system disorders were not yet determined as potential issues of a certain syndrome, functional neurological symptoms were noted among 12.6% cases. Sufficiently often among patients with HE stage II, signs of amyostatic

(40.2%), pyramidal (34.6%), vestibular cerebellar (9.4%) syndromes were revealed. Remarkably, that 64.7% amyostatic and pyramidal syndromes were combined. During the study of cognitive emotional spheres among patients with HE, emotional-volitional defects were detected in 32.7% cases among patients with HE stage I, while with HE stage II among 44.1% patients. The deficit of attention was registered among patients with stage I and II HE with an equal frequency – in 70.8% of cases. The study of gnostic functions, praxis and speaking during the neuropsychological examination has shown that the degree of severity of changes is determined by the nature of the course of HE. Considerably, that the intellectual deficit was not detected among patient with HE stage I, however, while there has been registered the increased fatigue level and the decreased rate of reaction. There was a memory deficit with a decrease of mnemonic functions, weakening of the logical and abstract memory, loss of professional skills, misunderstanding of logical – grammatical constructions and causal relationships, paralogy of conclusions, breach of calculation operations at HE stage II. The average total score on the MMSE scale in the group of HE stage I was  $26.7 \pm 1.3$  points, while in the group HE stage II was  $25.2 \pm 2.1$  points. Mild cognitive impairment (24-25 points) was detected in 70.5% of patients. Normal daily blood pressure was  $<130/80$  mm Hg, average blood pressure in the day –  $<135/85$  mm. Hg. and at night –  $<120/75$  mm Hg – considered normal. The meaning of the time index (TI) of hypertension to 25% was attributed to normal mark, with an excess of 25% – to definitely pathological, characteristic of hypertension, stable hypertension was diagnosed with TI at least 50% at daytime and at night (see Table 1).

Spectral analysis of cardiac rhythm variability showed a decrease in the values of the generally

**TABLE 1.** Time Index per day, day and night periods in the control group and in patients with HE stage I and stage II

Index	The value of the index (M $\pm$ m) in groups		P=
	HE stage I and II (n=300)	Control group (n=30)	
TI SBP 24 hours	70,89 $\pm$ 2,55	10,76 $\pm$ 0,98	0,001
TI DBP 24 hours	57,08 $\pm$ 2,73	5,63 $\pm$ 0,43	0,001
TI SBP day	65,64 $\pm$ 2,81	6,72 $\pm$ 0,83	0,001
TI DBP day	56,84 $\pm$ 2,92	4,73 $\pm$ 0,65	0,003
TI SBP night	79,23 $\pm$ 2,63	4,74 $\pm$ 0,93	0,001
TI DBP night	54,61 $\pm$ 3,20	0,9 $\pm$ 0,48	0,009

accepted indicators of the overall variability of the heart rate due to the weakening of the parasympathetic and the strengthening of sympathetic effects on the cardiovascular system (Table 2, Table 3).

In the general group of patients (79 participants) there were 44 females and 35 males. The average value of cerebral blood flow in the right hemisphere of the brain was noted at the level of  $36.9 \pm 2.5$  ml / 100 g / min, in the left -  $36.7 \pm 4.7$  ml / 100 g / min. ( $t = 0.03$ ,  $p > 0.05$ ).

In assessing the SPECT data (Table 3), the level of cerebral perfusion among patients with HE in the right hemisphere was -  $36.9 \pm 2.5$  ml / 100 g / min, in the left -  $36.7 \pm 4.7$  ml / 100 g / min., which indicates a marked decrease comparing to the control group ( $41.1 \pm 3.0$  ml / 100 g / min, and  $41.6 \pm 2.8$  ml / 100 g / min.).

According to SPECT among 41 patients (52%), the changes in cerebral perfusion were observed visually, which did not correspond to the parameters of the unaffected brain in the emission-tomographic mapping. There was noted a clear asymmetry of radioactivity in the cerebral hemispheres at 43.9% cases, due to reduced perfusion in the basins of the internal carotid arteries. The values of the volume of cerebral blood flow (CBF) in the hemispheres of the brain in patients of different ages were divided as described below.

The first group of patients (under the age of 45) had an average volume of cerebral blood flow in the right hemisphere of the brain was  $37.6 \pm 3.7$  ml / 100 g / min, and in the left -  $36.9 \pm 3.9$  ml / 100 g / min ( $t = 0.24$ ,  $p > 0.05$ ).

The second group of patients (45-60 years old) had an average volume of cerebral blood flow in

**TABLE 2.** Correlation matrix of HRV parameters in patients with HE stage I

	RR	SDNN	RMSSD	pNN50	Tr.ind	Bay.in	Am.mo	VLF	LF	HF	LF/HF	LFn	HF n
RR	1,00												
SDNN	-0,03	1,00											
RMSSD	-0,03	0,98	1,00										
pNN50	0,05	0,94	0,94	1,00									
Tr. Ind	0,17	0,69	0,61	0,75	1,00								
Bay.in	-0,29	-0,59	-0,60	-0,64	-0,53	1,00							
Am,mo	-0,10	-0,72	-0,71	-0,82	-0,74	0,70	1,00						
VLF	-0,02	0,68	0,55	0,60	0,61	-0,36	-0,52	1,00					
LF	-0,05	0,93	0,87	0,85	0,76	-0,45	-0,59	0,65	1,00				
HF	0,06	0,88	0,88	0,78	0,52	-0,49	-0,51	0,48	0,83	1,00			
LF/HF	0,18	-0,15	-0,13	-0,05	-0,01	-0,03	-0,01	-0,11	-0,13	-0,14	1,00		
LFn	-0,21	-0,13	-0,23	-0,26	0,07	0,48	0,18	0,05	0,03	-0,10	-0,31	1,00	
HFn.	0,22	-0,14	0,24	0,27	-0,06	-0,49	-0,19	-0,05	-0,02	0,11	0,31	-1,00	1,00

**TABLE 3.** Correlation matrix of HRV parameters in patients with HE stage II

	RR	SDNN	RMSSD	pNN50	Tr.ind	Bay.in	Am.mo	VLF	LF	HF	LF/HF	LFn	HF n
RR	1,00												
SDNN	0,27	1,00											
RMSSD	0,31	0,98	1,00										
pNN50	0,46	0,85	0,90	1,00									
Tr.ind	0,04	0,36	0,29	0,33	1,00								
Bay.in	-0,50	-0,62	-0,65	-0,73	-0,29	1,00							
Am,mo	-0,35	-0,57	-0,49	-0,54	-0,73	0,62	1,00						
VLF	0,29	0,92	0,86	0,67	0,34	-0,41	-0,52	1,00					
LF	0,21	0,85	0,80	0,55	0,26	-0,29	-0,35	0,95	1,00				
HF	0,22	0,94	0,91	0,70	0,28	-0,42	-0,43	0,96	0,97	1,00			
LF/HF	-0,39	-0,23	-0,40	-0,45	0,45	0,24	-0,31	-0,11	-0,14	-0,22	1,00		
LFn	-0,42	-0,16	-0,34	-0,43	0,43	0,30	-0,31	-0,03	-0,11	-0,17	0,94	1,00	
HFn	0,35	0,13	0,31	0,38	-0,47	-0,26	0,36	0,01	0,12	0,17	-0,90	-0,90	1,00

**TABLE 4.** The average volume of cerebral blood flow in the hemispheres of the brain in the groups of patients of different ages and in control groups

	General group, CBF, ml /100 g /min		group I CBF, ml /100 g /min		group II OMK, ml /100 g /min		group II OMK, ml /100 g /min	
	Experimental group	Control	Experimental group	Control	Experimental group	Control	Experimental group	Control
The right hemisphere	36,9±2,5*	41,1±3,0	37,6±3,7*	41,2±2,0	37,0±2,7*	43,1±3,8	37,5±3,5*	41,1±2,3
The left hemisphere	36,7±4,7*	41,6±2,8	36,9±3,7*	41,2±2,7	35,9±3,1*	42,2±3,3	38,1±2,9*	40,7±1,6

Note. \* -  $p < 0,05$  (comparison with the control group).

the right hemisphere of the brain of  $37.0 \pm 2.7$  ml / 100 g / min, and in the left one -  $36.0 \pm 2.6$  ml / 100 g / min ( $t = 0.35$ ,  $p > 0.05$ ).

The third group of patients (over 61 years of age) had an average volume of cerebral blood flow in the right hemisphere of the brain of  $37.5 \pm 3.5$  ml / 100 g / min, and in the left one -  $38.1 \pm 2.9$  ml / 100 g / min ( $t = 0.28$ ,  $p > 0.05$ ).

In the control group, the level of perfusion reached  $41.1 \pm 3.0$  ml / 100 g / min in the right and  $41.6 \pm 2.8$  ml / 100 g / min in the left hemisphere of the brain ( $t = 0,12$ ,  $p > 0,05$ ), which was significantly higher in comparison to the experimental group (right  $t = 0,9$ ,  $p > 0,05$ , left  $t = 1,03$ ,  $p > 0.05$ ).

## DISCUSSIONS

Increased digital values of the daily blood pressure, which were registered during the daily monitoring, are considered to be one of the main risk factors of the cardiovascular disease, given the proven existence of a direct connection of cardiovascular complications and the level of blood pressure. The level of systolic blood pressure fluctuated in the range 160-170 mm Hg, diastolic blood pressure – 100-110 mm Hg, which corresponds to the 2nd degree of hypertension.

Since the prognosis of hypertension is largely determined by the „remodeling“ of blood vessels, the frequency of risk factors including BMI, left ventricular hypertrophy (LVH), retinal disorders and hypercholesterolemia at HE stages I and II were studied. The results of the comparative analysis have shown, that vascular lesions of the retina, signs of hypertension and hypercholesterolemia were more common for patients with HE stage II, than those with HE stage I.

Remarkably, that together with the level of the blood pressure, dyslipidemia and smoking, as an

independent factor of vascular risk, there was considered an elevated homocysteine level. It has been discovered, that the normal level of HC was common for the majority of patients with HE (64.7%), moderate increase of HC was observed in 5.9% of cases, the average degree of increase in HC was found in 26.5% of patients, and a significant degree – only among 2, 9% of patients. Consequently, an elevated level of homocysteine among patients with HE increases the risk of vascular complications.

The study of clinical and neurological features of HE revealed its peculiarities of the process. Neurological symptoms and progression of the disease gradually increased among patients with HE stage I. The cephalalgic syndrome of polymorphic nature with varying intensity of pain occurred in 98% cases. The cognitive deficit was detected among 85% of patients and was characterized by a weakening of a verbal memory among 60% of patients, 85% of patients reported a sleep disorder.

Vegetative dysfunction was characterized by polymorphism, polysymptomy with the involvement of two or more functional systems. There were registered cardiovascular, vegetative-visceral, neuroendocrine and vegetative-trophic disorders. Neurological, vegetologic and neuropsychological examination confirmed the polyfunctionality of deficit already at the early stages of the formation of HE, which is indicative, in particular, for dysfunction of the structures of the limbic-reticular complex.

The examination of the cognitive disorder manifestation among the patients with HE I stage II and atherosclerotic genesis of the II stage, has revealed the memory deficit of the modal-nonspecific nature. That means that segments of short-term and long-term memory are damaged, however, with the

HE atherosclerotic genesis originally these changes were more pronounced. Disorders of spatial orientation, elements of spatial hypognosis were observed among 59.2% with HE stage II and in 65.7% of patients with the HE atherosclerotic genesis stage II. To the manifestations of mental disorders belonged difficulties of the execution of arithmetic operations and choosing the right words. These patients were characterized by changes in the higher cortical functions (violation of reading and correspondence) associated with brain damage.

One of the clinically meaningful characteristics of neurosis-like states among patients with HE is the presence of signs of worsening of condition and increase of complaints during the elevated blood pressure. During the study related to the role of depressive and anxiety symptoms in the formation of a clinical picture of HE, there have been discovered a positive connection between the subjective manifestations which typical to HE and the severity of depressive and anxiety states. The obtained results confirm the significance of the psychosomatic component in the formation of HE and indicate the expediency of incorporating methods of correction of the psycho-emotional state into the structure of complex treatment of patients.

The study concerning peculiarities of the daily blood pressure profiles among patients with HE has revealed significantly greater clinical evidences in comparison to the traditional way of measuring blood pressure. Moreover, expanded the medical and diagnostic capabilities. These evidences of the dependance between the daily blood pressure indicators, damage degree of the target organs and risk factors of cardiovascular complications among patients with hypertension are important for the stratification of patients, depending on the degree of changes in the daily parameters of blood pressure.

The conducted studies have shown, that the daily blood pressure indicators with consistently high systolic, diastolic and pulse levels, significantly exceeded the regulatory level indicators “load pressure», especially on the SBP (systolic blood pressure) at night, in comparison to results among patients with HE stages I and stages II with the control group. The increase in the magnitude of the morning elevation of diastolic blood pressure is also established. These results coincide with the Ohasama study (2005), which have proved that the

levels of morning and evening blood pressure provide enough information to determine the risk of stroke.

The comparative analysis of the features related to changes in the indicators during daily blood pressure monitoring, has shown, that the level of increase of systolic blood pressure over all periods of the day among patients with HE stage II significantly exceeds the level of systolic blood pressure among patients with HE stage I, especially at night (more at 13,99 mm Hg). The level of diastolic blood pressure in the daytime between the groups did not differ, moreover, the parameters of HE stage II were higher at night as well. Consequently, the peculiarity of the pulse blood pressure disturbance over the day and night, similarly to the features of systolic blood pressure, was higher among patients with HE stage II.

According to the value of the degree of nighttime reduction of blood pressure, the physiological circadian rhythm of blood pressure (dipper), according to the data of the study, was observed more often in the HE stage I, and insufficient reduction of systolic blood pressure dominated among patients with HE stage II (61.7%). Nightly hypertension was only registered among patients with HE stage II (2%), and excessive reduction of systolic blood pressure at night was observed among patients with almost identical frequency - 48.9% at HE stage I and 51.1% at HE stage II respectively. Disturbance of circadian rhythm, such as non-dipper and night-piker, was combined with the highest possible level of increase of the average systolic and diastolic blood pressure. There was detected a significant blood pressure increase in value and in speed during the early morning hours among patients with over-dipper type of circadian rhythm of blood pressure. This should be interpreted as a prognostically unfavorable sign regarding the development of cerebrovascular complications during this period of time. Excessive blood pressure at night is defined as an additional risk factor for ischemic stroke (Metoki H., 2006).

The increased variability of blood pressure, primarily systolic, in daylight hours, is considered as a predictor of the risk of cardiovascular complications and mortality in hypertension. The variability of systolic blood pressure correlates with the degree of dilatation of the carotid artery with changes

in the structure of other large arteries, which may determine the increased risk of cerebrovascular complications and affects cognitive dysfunction.

There was an increase in the variability of systolic and diastolic blood pressure in patients with HE in hypertension. The level of increase in the variability of systolic blood pressure and diastolic blood pressure both in the daytime and at night in patients with HE stage II significantly exceeded the magnitude of the variability of blood pressure in patients with HE stage I ( $p < 0.05$ ).

The group of examined patients was divided into 3 groups depending on the level of variability of blood pressure, in order to study the features of the variability of blood pressure in patients with HE stage I and stage II. The first group consisted of patients with normal variability of systolic blood pressure and diastolic blood pressure, the second - with marginal variability values (for systolic blood pressure – 15 mm Hg drops day and night, for diastolic blood pressure – 14 mm Hg daytime and 12 mm Hg at night), and the third contained combined patients, where variability of the blood pressure exceeded the limit level.

It was found that only patients with normal pressure variability (Group I) have a significantly lower level of systolic blood pressure compared with marginal and high variability, without significant differences between II and III groups for all analyzed periods of the day. The groups did not differ depending on the increase degree in the variability of blood pressure (according to the level of diastolic blood pressure patients). Analysis of the peculiarities of vegetative status among patients with EG indicated a reduced type of vegetative reactivity. It was revealed that patients with pathological circadian rhythm of blood pressure (non-dipper and night-piker) were more often observed concerning insufficient vegetative maintenance of activity with parasympathicotonia.

Due to the results of the multivariate correlation analysis, there was revealed the association of the daily variability of systolic blood pressure with the duration of the disease and the age of patients ( $r = 0.34$  and  $r = 0.30$ ;  $p < 0.05$ ) only in III group, where the variability was the highest. It was found a connection between the variability of systolic blood pressure and diastolic blood pressure at night and in the age of patients in the first group ( $r = 0.44$ ;  $p$

$< 0,01$  și  $r = 0,39$ ;  $p < 0,05$ ). This indicates the influence of age on the increase in the variability of blood pressure at night in normotensive patients. Among the patients with marginal variability (group II), the daily variability of systolic blood pressure was associated with the rate of morning rise in pulse blood pressure and diastolic blood pressure ( $r = 0.38$  and  $r = 0.35$ ;  $p < 0.05$ ). The variability of blood pressure was most influenced by the level of systolic blood pressure in the morning, the magnitude of the pulse blood pressure and the «load pressure» during the day in the third group. The results of the study showed that the nature of the course of HE in hypertension is determined not only by the level of increase in the variability of blood pressure, but also by the value of the dynamic characteristics of short-term fluctuations of blood pressure over the course of a day. The increase of the HE stage was accompanied by a decrease in the number of patients with single sharp drops of high-pressure blood pressure, recorded predominantly during the day, and an increase in the number of patients with frequent fluctuations of the minimum and the average amplitude during the day, which are associated with the most unfavorable course of disease in the HE II stage.

According to SPECT indicator, a crossed cerebellar diaschisis is caused by depression of metabolism in intact brain regions, located away from the area of ischemia. The detected changes, such as interhemispheric asymmetry of blood supply, focal reduction of white matter perfusion, hypophthontality and the presence of crossed cerebellar diaschisis, were related to the same type and differed only in degree of severity.

## CONCLUSIONS

1. It has been proven that changes in the nervous system have a tendency to increase with the progression of the disease: for the patients with HE 1 degree predominate subjective complaints and diffused neurological symptoms. For HE 2nd patients there were registered signs of amiotatic (40.2%), pyramid (34.6%) and vestibular cerebellar (9,4%) syndromes.

2. It has been established that changes in the parameters of the blood pressure profile for patients with HE stage I, in contrast to those with HE stage

II, were related to an increase in pulse blood pressure (especially at night). Moreover, these changes were related to the increased speed the blood pressure monitoring, maximal systolic blood pressure variability increase. Furthermore, these changes were influenced by the diastolic blood pressure during the day and night and a high frequency (78.4%) of circadian rhythm disturbances of the blood pressure. This combination of features should be considered as predictors of high risk of cardiovascular complications. Excessive reduction of blood pressure at night indicates evidence of progression of HE.

3. High pulse pressure is accompanied by a deficit of brain perfusion (according to SPECT) and this is an independent risk factor for the development of HE.

4. At the higher HE development stage has reduced the number of patients with the single sharp

drops in the blood pressure and high amplitudes mainly in the afternoon. Higher HE development stage, increases the number of patients with frequent fluctuations of blood pressure of minimum and average amplitude during the day. These fluctuations have a negative effect on the severity of the disease. Estimation of dynamic characteristics of the blood pressure based on the data of daily blood pressure monitoring allows us to predict a variant of the unfavorable course of the disease.

5. According to SPECT among 52% of patients with HE, there were displayed the signs of blood supply to the brain. These signs manifested in the form of a one-sided reduction of perfusion in a carotid pool with the presence of signs of hypoperfusion in the projection of white matter of the hemisphere. The symptoms of crossed cerebellar diaschisis registered among 26.8% of patients.

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