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Peculiarities of Clinical and Hemodynamic Manifestations of Migraine Strokes

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Abstract— *Migraine often causes strokes among patients under 50 years of age in 1 to 17% of cases, and repetitive migraine paroxysms lead not only to chronic migraine but also to vascular complications of the brain. Often, diagnoses of "dumb heart attacks", "iatrogenic strokes", and "strokes of unknown etiology", which are the result of severe migraine crises resulting in dumb subcortical heart attacks and persistent leukoencephalopathy, can still be seen in practitioners' diagnoses. The aim of the study was to study the clinical and hemodynamic features of migraine strokes. The study examined 84 (100%) patients, 52 (61.9%) with migraine strokes (1-major group) and 32 (38.1%) with ACVD against the background of HD (hypertension disease) and A (atherosclerosis) (2-comparative group). Clinical-neurological studies, EEG and TCDSs of brain vessels were carried out, the coma scales of Glazko, Scandinavian and American (NIHSS) three-dimensionalscales (VRS, NRS, VAS) and facial pain scales FPS, ID-migraine and MIDAS were used. Patients with migraine stroke were observed to have a severe condition with a sudden and rapid clinical course, acute onset against the background of regular migraine attacks, due to the typical vascular type of migraine, caused by dystonia of the brain vessels. Migraine strokes and ACVD against the background of HD and A, having different etiopathogenic factors of the disease development, lead to the formation of the same pathological link, i.e. the zone of ischemic focus in the brain with all its neurological manifestations and complications, which ultimately require close attention, differentiated approach and timely correction. The choice of preventive and restorative therapy of migraine strokes should be directed towards the elimination of cause-effect factors of disease formation, because only in this case it is possible to mediate persistent, prolonged manifestations of the disease in the form of motor, sensitive, psychopathological, cognitive and vegetative disorders.*

Keywords—*migraine, migraine stroke, stroke against hypertension and atherosclerosis, MIDAS scale, ID-migraine, Glazko coma scale, Scandinavian and American (NIHSS) scales, three-dimensional pain scale (VRS, NRS, VAS) and facial pain scale (FPS).*

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I. INTRODUCTION

The twentieth century was a century of accelerated pace of life, stressful situations, psycho-emotional tension, which resulted in increased headache. The growth of migraine up to 60% in the population over the past 10 years is really impressive and is a serious medical and social problem of interest to scientists, practitioners, as well as health care institutions [4, 10]. Migraine is also interesting because frequent attacks cause not only chronic migraine but also vascular complications of the brain [6, 21]. Diagnoses of “mute heart attack”, “iatrogenic stroke”, “small stroke”, “cryptogenic stroke”, and “stroke of unknown etiology”, which are often the result of severe migraine crises resulting in “mute” subcortical heart attacks and persistent leukoencephalopathy, are not uncommon in practitioners' diagnoses [17, 20]. According to some authors, stroke was associated with migraine among patients under 50 years of age from 1 to 17% of stroke cases [2, 5]. In another prospective analysis conducted in Switzerland in 2001, among 3502 cases of ischemic strokes, 3.7% were identified as migraine, in which during 10 years of observation, migraine was verified with a frequency of at least 1 attack in 2 months, and the age analysis showed that in persons under 45 years of age, migraine associated with a stroke was found to be up to 15.8% compared to 2.1% in the control group [4, 8, 12].

A large population-based study by the Oxford shire Community Stroke Project found that at less than 50 years of age, a migraine heart attack is observed to be as high as 25% of all cerebral heart attacks [11, 14, 15, 19]. A study by European scientists has shown that the presence of migraine in women (20-44 years of age) increases the risk of ischemic stroke by a factor of 3.5, and the combination of the disease with other risk factors (oral contraceptives, increased blood pressure, and smoking) further increases the risk of vascular and cerebral palsy [1, 3, 16]. According to the authors, 20 to 40% of strokes in women coincided with a migraine attack and 67-73% of cases were preceded by a migraine attack within 3 days [7, 9, 21]. British researchers have proven the effect of the duration, frequency, and age of migraine on the risk of ischemic stroke, and in their opinion, a decrease in the frequency of attacks is the main therapeutic goal [13, 18]. These data once again prove that migraine is not just a headache, but a complex pathophysiological mechanism that causes deep damage to brain structures with degenerative changes.

Proceeding from the above mentioned, the **aim** of our study was to study clinical and hemodynamic features of migraine strokes.

II. MATERIAL AND METHODS OF RESEARCH

The study included 84 (100%) patients, 52 (61.9%) with migraine strokes (1-major group) and 32 (38.1%) with ACVD against the background of hypertension (hypertension) and A (atherosclerosis) (2-comparative group) (Fig. 1). Clinical-neurological studies were carried out. The state of consciousness and the degree of neurological deficits were determined according to the Eye Coma, Scandinavian and American (NIHSS) scales. Methods of qualitative and quantitative assessment of pain intensity using three-dimensional pain scale (VRS, NRS, VAS) and facial pain scale FPS were used, the degree of migraine severity and reduced performance of patients with complicated migraines were determined using the ID-migraine and MIDAS questionnaire.

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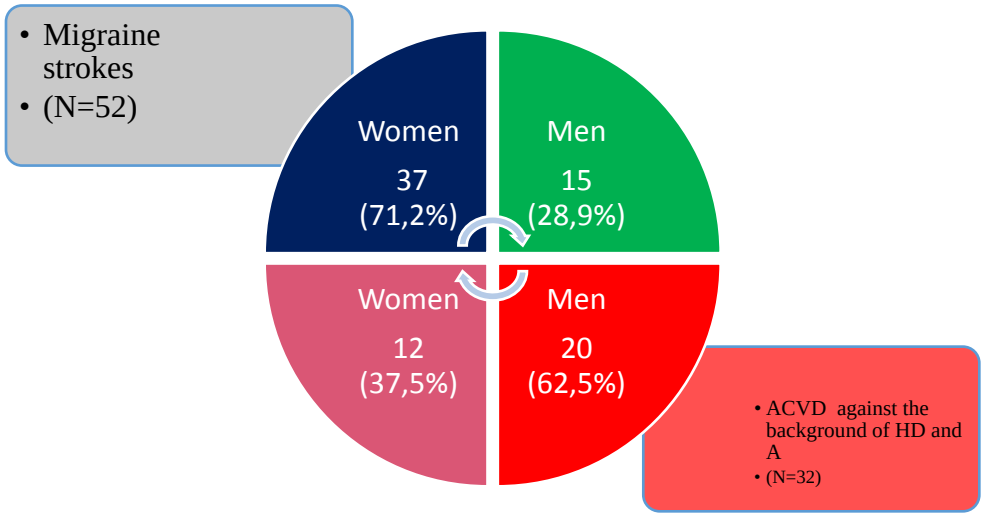

Figure 1 Distribution of those surveyed by gender

III. RESEARCH RESULTS

We carried out a comparative analysis of the frequency of migraine stroke and ACVD on the background of HD and A by age category (Fig. 2). As can be seen, the youngest age at migraine stroke prevailed almost 6 times among the patients with ACVD and A in childhood compared to the comparative age ($p<0.001$), whereas the mean age was 3.3 times more frequent at ACVD and A ($p<0.05$), but the elderly age was not verified at migraine stroke, and therefore it was not possible to carry out its comparative analysis.

Patients with migraine strokes suffered from different variants of the clinical course of migraine. Thus, in 28 (53.9%) studied patients the transformation of chronic migraine into a migraine stroke was observed on the background of migraine paroxysm, in 16 (30.8%) on the background of migraine status, and in 8 (15.4%) it was formed on the background of migraine attack in uncomplicated migraine.

According to the results of Scandinavian, American (NIHSS) scales, and Glazko's coma scale in case of migraine stroke revealed 46 (88.5%) severe and 6 (11.5%) patients in the state of moderate severity, and 26 (86.7%) patients with severe condition and 4 (13.3%) patients with the state of moderate severity were observed in case of ACVD against the background of HD and A. No lethal outcomes were observed at the time of the examination in either migraine strokes or in case of ACVD on the background of HB and A, however, in contrast to migraine strokes, 2 (6.7%) patients with ACVD on the background of HB and A were discharged due to the severity of the condition (at the request of relatives).

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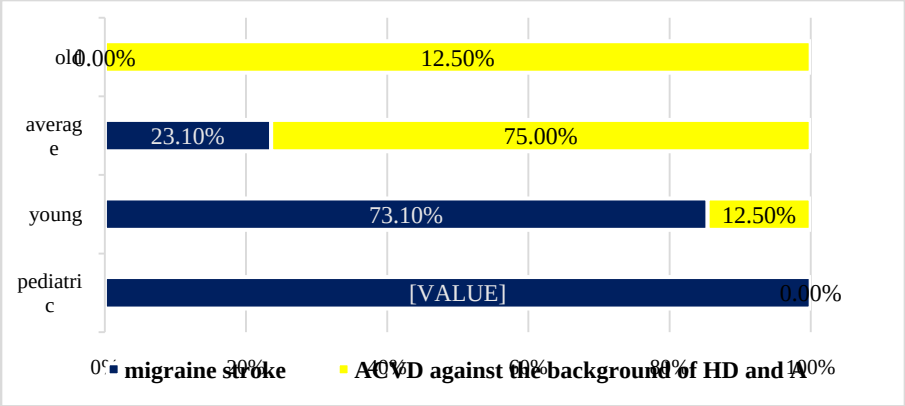

Figure 2 Comparative analysis of disease frequency by age

The average clinical score on admission in patients with migraine stroke was 29.4±6.3 on the Scandinavian scale and 16.6±5.2 on the NIHSS scale, which in both cases corresponded to a severe clinical degree. Clinical course of migrainetic stroke by age category was considered on the example of Table 1.

Table 1 Clinical course of migrainetic stroke by age group

Age (y.o.)	**Illness duration (year)**	**Stroke duration (day)**	**Bright gaps (day)**	**The presence of convulsions (%)**	**Seizure frequency at 3 months**	**Presence of an aura (%)**
Baby...	1,3 ± 1,6	5,5 ± 3,2	-	1,9 ± 1,9	6,2 ± 3,3	100,0
Young...	7,4 ± 3,4	7,9 ± 7,4	3,4 ± 2,5	-	7,1 ± 3,6	53,9
Average	8,7 ± 3,8	5,7 ± 3,2	-	-	6,4 ± 3,4	17,3

In a fully preserved consciousness with adequate reactions to surrounding events 43 (82.7%) patients came in. Violation of consciousness of different degree of severity was noted in 9 (17,3%) patients surveyed. Of them, according to the assessment of the degree of unconsciousness disturbance according to the Glasgow coma scale, 6 (11.5%) patients showed stunnedness - unconsciousness disturbance in case of some verbal contact with higher threshold of perception of external stimuli. In 3 (5.8%) patients, the consciousness was turned off with coordinated reactions preserved and the eyes opened for elementary verbal contact, i.e. the sopor. The migraine stroke with “migraine with aura" was detected in 47 (90.4%) patients. Of these, sensory aura was observed in 12 (23.1%) and visual aura in 35 (67.3%) cases, the aura lasted longer than usual, up to 45-60 minutes. The age category of aura is shown in Table 1, where there was a worsening of the disease flow, consciousness, psycho-emotional status and discomfort in the head region, the clinic of headache was heavier than usual, and as can be seen from the table, the younger the patients were, the more often the aura was observed. The consciousness of the enrolled children was preserved, the general condition was severe, in the history of frequent migraine attacks lasting an average of 132.0 hours (up to 5.5±3.2 days), both children had an aura lasting up to 60 minutes, visual character, one child (1.9%) had seizures, against the background of hemicrania and focal neurological symptoms. All patients with migraine stroke were subject to inpatient treatment, therapy was carried out in the intensive neurology department. After 10-15

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minutes after the beginning of the stereotype aura, both 3.9% of children started hemicrania, while the aura continued. After some time, hemicrania was transformed into a diffuse headache and lasted for 5-6 days, and sometimes up to 7 days, without light intervals. At a young age, the character of headaches at the beginning of attacks turned out to be pulsating, and after a while they held on as a squeezing-pressure. In 28 (53,9%) young patients' migraine attacks debuted with prolonged aura for more than 60 minutes, of which 17 (32,7%) had visual aura, in the form of flashing light flashes in front of eyes, zigzags, spirals, in 11 (21,2%) sensitive, in the form of tingling in the fingers of the hand, spreading over the entire arm, covering half of the face, tongue and half of the body, with 9 (17.3%) patients had periods of light gaps between headaches, while 29 (55.8%) did not have them at all. In the middle age, the headache was of diffuse character, accompanied by head severity and blurredness, and patients answered the questions with some retardation. According to the analysis data it follows that migraine, regardless of its flow variants - migraine status, chronic migraine, uncomplicated forms have a high probability to transform into a developed acute disturbance of cerebral blood circulation, against the background of next migraine paroxysms.

To differentiate migraine strokes from strokes of hypertensive and atherosclerotic genesis, a comparative analysis was performed to assess the severity and degree of neurological deficit in patients with ACVD against the background of HD and A according to the Scandinavian and American (NIHSS) scales, The average clinical score for patients with ACVD on the background of HD and A was 21.3±1.9 on the NIHSS scale, and 13.2±1.6 on the Scandinavian scale, which, as well as for migrainetic strokes, corresponded to a severe course of the disease. In full preserved consciousness 6 (20%) patients with ACVD were admitted against the background of HD and A. Violation of consciousness of different degree of severity was noted in 24 (80%) patients (which was 4.6 times higher than in case of migraineous stroke). Of these, according to the Glasgow coma scale, 12 (40%) patients had stunned and decreased brain activity. In 6 (20), the consciousness turned off with the preservation of coordinated reactions and the opening of eyes to stimuli, i.e. sopor, while in the remaining 6 (20%) patients, the state of unconsciousness with complete absence of contact with surrounding events and mental activity, the absence of reactions of opening eyes to strong stimuli was determined. As it can be seen, according to the Glazko's coma scale, Scandinavian scale and NIHSS scale, the general condition of the patients was heavier in case of ACVD against the background of HB and A in contrast to the migraine stroke, there was no characteristic for migraine aura, there was no concept of "light intervals", did not reveal hemicranial headaches and did not use the term "paroxysmal", but the symptoms of focal neurological deficit, disease formation, unconsciousness, development and dynamics of the disease had a single pathophysiological mechanism both in case of ACVD against the background of HD and A, and against the background of migraine strokes. Proof of all the above was the existing dysfunction of the vascular wall on the type of dystonia, due to prolonged vasodilation/vasospasm, with a decrease in the elasticity and tone of the vascular wall, which eventually led to a violation of blood flow with the development of hypoxia, and later ischemia of the circulating region, with the formation of a local encephalomalacia region, with consequent focal abnormalities in case of migrainetic stroke, whereas the blood flow abnormalities in the background of hypertension and atherosclerosis were caused by vascular wall rigidity, atherosclerotic plaques blocking vascular lumen and

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hemodynamically significant stenoses, which prevented normal blood flow, finally with the formation of ischemic focus and cerebral edema, as well as in case of migraine stroke.

Comparison of the ID-migraine questionnaire for migraine stroke revealed that, despite the severe condition, 38 (73.1%) of the studied nausea was short-lived, with 14 (26.9%) during the whole period of headaches noted calls to vomiting without nausea. Repeated vomiting did not bring relief, but decreased at the first symptoms of focal symptoms. In comparison, nausea and vomiting were treated more severely than with ACVD in the background of HD and A and preceded paroxysms of migraine attack. In 18 (34.6%) cases, sudden severity was observed in the head against the background of nausea, without headaches, followed by repeated vomiting, unconsciousness and focal neurological symptoms. Nausea, which was observed in parallel with phonophobia and photophobia, statistically distinguished migraine strokes from ACVD against the background of HD and A. Statistically significant difference in the number of patients with reduced efficiency between the main and comparative groups was not observed, and was observed in all 100% of patients.

In 12 (23,1%) studied patients with migraine stroke on the background of headaches, nausea and vomiting observed the appearance of dizziness of systemic nature, which were characterized by a severe condition, there was a fear of the slightest movement, because of the possible deterioration of the condition. In 14 (26,9%) patients the feeling of phonophobia and photophobia along with vomiting caused fear of death, anxiety, anxiety and depression, and therefore patients were asked not to leave them during the procedures. Phobia continued for a long time, even when patients were discharged from hospital.

Thus, patients with migraine stroke were observed to have a severe condition with a sudden and rapid clinical course, acute onset against the background of regular migraine attacks, due to the typical type of vascular reaction in migraine, caused by dystonia of the brain vessels.

According to the study, 3 (5.8%) patients with migraine stroke on the MIDAS scale showed a first-degree decrease in performance, which was proportional to the state of minimal migraine severity. Based on the results of the pain scales, it was determined that at the I minimum degree of migraine headache was expressed as low intensity/minor pain on the VRS scale, 1 - 3 linear gradation on the NRS scale, no pain on the VAS scale, 1 - 2 points on the facial scale (FPS). In 9 (17,3%) patients we observed II, mild degree of migraine severity. At the same time, the headache was diagnosed as moderately severe on the VRS scale, on the NRS scale it was equal to 4 - 6 linear gradations, there was no pain on the VAS scale, and on the FPS facial scale - 3 points, and performance was reduced to a slight degree. In 28 (53.9%) examined a moderate degree III of migraine severity was noted, with headaches characterized by strong VRS intensity, linear NRS gradation of 7-10, severe VAS headaches, and 4 FPS facial scale scores, performance was rated as a moderate decrease. Twelve (23.1%) patients had a severe IV degree of migraine severity, with a severe headache on the VRS scale, 7-10 linear gradations on the NRS scale, a severe headache on the VAS scale, and 5 points on the facial pain scale of the FPS, with daily activity (performance) assessed as severe. This scale was not applied to ACVD patients with HB and A background.

Based on clinical symptoms of the disease, a survey was conducted on the depression scale of HDRS-21, according to which 33 (63.5%) patients with migraine stroke were found to have a depressive disorder (Table 2).

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Table 7 Severity of depression in patients with migraine stroke in age-related aspects (n=33)

Patients' age	Depression severity degrees					
	Light degree		Mean degree		Severe degree	
	Abs	%	Abs	%	Abs	%
Total number	3	9,1	24	72,7	6	18,2
Baby...	-	-	2	6,1	-	-
Young...	3	9,1	18	54,5**	4	12,1*
Average	-	-	4	12,1**	2	6,1*
** p<0,05; **p<0,001 * p<0.05; **p<0.001 Comparison of anxiety between age groups*						

Analyzing the findings, we found that among the severity of depression in migraine stroke the average degree was higher than 8 times the mild degree () and 4 times the severe degree ($p<0.05$). In age-related analysis, depression in all degrees of severity was more common in young age ($p<0.05$; $p<0.001$). Patients with depressive disorders had frequent migraine paroxysms, worsening pain syndrome intensity and lengthening of seizures, which aggravated the clinical course of the disease and the period of recovery of lost functions. Depression in 14 (43.8%) patients, mostly middle-aged, with reduced emotional background, slower thinking, motor retardation, reduced self-esteem and loss of interest in surrounding events, were found to be 1.5 times less than in migraine strokes ($p<0.01$). Mild depression was 3.7 times ($p<0.05$) more common in 4 (33.3%) subjects, but the number of moderate depression had no statistical difference with migraine stroke in 8 (66.7%) patients. Severe depression was not registered in any case in patients with ACVD on the background of HD and A. The smaller number of depressions detected in this group of patients and the absence of a more severe degree of its severity, in our opinion, was associated with a small number of patients in the comparative group, as well as disturbances of consciousness of varying degrees of severity in the acute stage, but not the disease itself.

Phonophobia, photophobia, nausea, and prolonged intense headaches became the cause of anxiety in patients with migraine stroke. Thus, according to the HAM-A alarm scale, 38 (73.1%) patients with migraine stroke showed anxiety disorders of varying severity (Table 3).

Table 3 Age-related severity of anxiety in patients with migraine stroke (n=38)

Age of patients	Degrees of anxiety							
	Possible anxiety		Anxiety		Symptomatic anxiety		Expressed anxiety	
	Abs	%	Abs	%	Abs	%	Abs	%
Total	3	7,9	9	23,7	10	26,3	16	42,1
Baby	1	2,6	1	2,6	-	-	-	-
Young	2	5,3	6	15,8*	3	7,9*	13	34,2**
Average	-	-	2	5,3*	7	18,4*	3	7,9**
** p<0,05; **p<0,001 Comparison of anxiety between age groups*								

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As can be seen from the table, anxiety, symptomatic and anxiety prevailed in migraine strokes, while frequent anxiety and a state of severe anxiety ($p<0.001$) prevailed in young adults and symptomatic anxiety prevailed in middle-aged patients ($p<0.05$).

The presence of anxiety in patients with ACVD on the background of HD and A was found in 16 (50%) of middle-aged patients, which was 1.5 times less common than in case of migraine stroke ($p<0.01$), and it was accompanied by fear of death, various phobias. Analyzing the degree of severity, it was revealed that in patients of this group anxiety disorders were found in 5 (31.3%) cases, the number of which was 1.3 times higher than in case of migraine stroke ($p<0.01$), while symptomatic anxiety was observed 2.6 times higher than in the main group, comprising 11 (68.8%) patients ($p<0.05$).

Thus, both considered pathologies having different etiopathogenetic factors of the disease development lead to the formation of the same pathological link, i.e. the zone of the ischemic focus of the brain with all its manifestations and complications, which ultimately require close attention, differentiated approach and timely correction.

IV. CONCLUSIONS

1. In case of migraine strokes, as well as in case of ACVD, on the background of HD and A, there is a severe condition of patients with sudden and rapid clinical course, acute beginning, which differ from the latter in the presence of migraine paroxysms, with vascular reaction formation, on the type of vasodilation/vasoconstriction, as a consequence, the development of the whole pathogenetic mechanism of brain perfusion disorder;
2. Migraine paroxysms, being the main cause of development of pathophysiological mechanism of vascular conflict formation, lead to damage of psycho-emotional background, causing psychopathological state, by type of depression and anxiety, which is fraught with aggravation of clinical course of vascular complications of migraine, prolongation of morbidity period;
3. The formation of psychopathological state in migraine strokes is a consequence of dissimulation and structural changes in the hypothalamic, limbic, sub-cortical and cortical areas of the brain, which mutually aggravate the symptoms and exacerbation of migraine;
4. The choice of preventive and restorative therapy of migraine strokes should be directed towards the elimination of cause-effect factors of the disease, because only in this case it is possible to mediate persistent, prolonged manifestations of the disease in the form of motor, sensitive, psychopathological, cognitive and vegetative disorders.

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