

# Assessment of Psychoemotional and Cognitive State in Patients with Ischemic Stroke on the Background of Metabolic Syndrome Using Tests

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**Abstract** Metabolic syndrome can be evaluated as an independent factor that aggravates the course of ischemic stroke and increases the risk of developing psychoemotional and cognitive disorders. It is necessary to apply regular testing methods to assess the psychoemotional and cognitive state in patients with metabolic syndrome who have had a stroke, and to develop early rehabilitation measures.

**Keywords** Metabolic syndrome, Ischemic stroke, Psychoemotional state, Cognitive disorders, Depression, Anxiety, MMSE, MoCA, Beck scale, Spielberg-Khanin scale

## 1. Introduction

Stroke occupies one of the leading positions among the causes of disability and death worldwide. According to the World Health Organization, more than 15 million people worldwide suffer strokes each year, and approximately one-third of them die, while another third suffers permanent disability [1,2]. One of the main factors determining the quality of life of patients in the post-stroke period is their psychoemotional and cognitive state [7,8]. In recent years, numerous studies have been conducted on metabolic syndrome (MS) and its effect on stroke progression. Metabolic syndrome is a complex pathological condition that includes components such as central obesity, arterial hypertension, dyslipidemia, and impaired glucose tolerance, all of which increase the risk of cerebrovascular diseases [3,4]. Scientific works devoted to the relationship between ischemic stroke developed against the background of metabolic syndrome and psychoemotional and cognitive disorders are limited. Additionally, post-stroke depression, anxiety, and cognitive impairments are closely interconnected, reduce the effectiveness of rehabilitation, and negatively affect the level of functional recovery of patients [5,6].

**The purpose of this study** is to assess the psychoemotional and cognitive state of patients with ischemic stroke developed against the background of metabolic syndrome using standardized tests and to determine their significance in the clinical course.

## 2. Materials and Methods

The study was conducted during 2023-2024 at the Republican Specialized Center of Neurology and Stroke. 120 patients diagnosed with ischemic stroke were included in the study. Metabolic syndrome was identified in 76 of them (63.3%), who formed the main group, while 44 patients (36.7%) without signs of metabolic syndrome were included in the comparison group.

The diagnosis of metabolic syndrome was established according to the criteria of the International Diabetes Federation (IDF, 2005). According to the criteria, central obesity (waist circumference  $\geq 94$  cm in men,  $\geq 80$  cm in women) and at least two of the following criteria must be present:

- triglyceride level  $>1.7$  mmol/L or treatment for hyperlipidemia;
- high-density lipoprotein level  $<1.03$  mmol/L in men,  $<1.29$  mmol/L in women;
- arterial blood pressure  $\geq 130/85$  mm Hg or treatment for hypertension;
- fasting plasma glucose level  $\geq 5.6$  mmol/L or previously diagnosed type 2 diabetes.

The diagnosis of stroke was confirmed by brain CT or MRI examinations. Inclusion criteria for the study were: acute ischemic stroke, age 45-75 years, moderate neurological deficit (5-15 points on the NIHSS scale), and informed consent. Exclusion criteria included severe post-stroke condition (NIHSS  $>15$ ), severe somatic diseases, psychiatric disorders, brain dementia or severe cognitive impairments in the anamnesis, alcoholism and drug use, and inability to establish verbal contact.

The assessment of psychoemotional and cognitive state in patients was carried out using the following tests:

#### Tests for assessing cognitive functions:

1. **MMSE (Mini-Mental State Examination)** - a 30-point scale that assesses orientation, memory, attention, calculation, speech, and constructive praxis. 24-30 points - normal, 18-23 points - mild cognitive impairment, 10-17 points - moderate cognitive impairment, less than 9 points - severe cognitive impairment.
2. **MoCA (Montreal Cognitive Assessment)** - a 30-point test that assesses executive functions, visual-spatial abilities, attention, memory, and others. 26-30 points - normal, 19-25 points - mild cognitive impairment, 11-18 points - moderate cognitive impairment, less than 10 points - severe cognitive impairment.

#### Tests for assessing psychoemotional state:

1. **Beck Depression Inventory (BDI-II)** - a questionnaire consisting of 21 questions, with each question rated from 0 to 3. Total scores: 0-13 - no depression, 14-19 - mild depression, 20-28 - moderate depression, 29-63 - severe depression.
2. **Spielberg-Khanin Anxiety Scale** - a test that allows the assessment of reactive (situational) and personal (trait) anxiety. Each scale consists of 20 questions. Total scores: 0-30 - low level, 31-45 - medium level, 46 and above - high level.

Examinations were conducted twice - 7-10 days after the stroke and 3 months later. The obtained data were statistically analyzed, mean values were expressed with standard deviation ( $M \pm SD$ ). Intergroup differences were assessed using Student's t-test and Mann-Whitney U-test. Differences were considered statistically significant at  $p < 0.05$ .

### 3. Results of the Study

The demographic and clinical characteristics of the patients included in the study are presented in Table 1. No statistically significant differences were observed between the two groups in terms of age and gender distribution. It was found that the severity of stroke according to the NIHSS scale was slightly higher in the main group, but this difference was not statistically significant.

In patients with metabolic syndrome, risk factors such as arterial hypertension, dyslipidemia, and diabetes mellitus were observed to be significantly more frequent compared to the control group (Table 2).

Based on the results of a cognitive function assessment conducted on 7-10 days after a stroke, it was found that cognitive impairment was significantly more severe in patients with metabolic syndrome compared to the control group (Table 3). The average MMSE test score was  $21.3 \pm 2.1$  in patients with metabolic syndrome, and  $24.5 \pm 1.8$  in the control group ( $p < 0.01$ ). Under the MoCA test, cognitive functions were rated at  $19.8 \pm 1.9$  and  $22.7 \pm 1.7$ , respectively ( $p < 0.01$ ).

3 months after the stroke, positive dynamics of cognitive function were observed in both groups. However, the level of cognitive impairment in patients with metabolic syndrome remained high compared to the control group. After 3 months, lower than 24-point rates (cognitive distortions) on the MMSE scale were found in 61.8% (47/76) of patients with metabolic syndrome, while in the control group the rate was 25.0% (11/44) ( $p < 0.01$ ). The results of the psychoemotional status assessment showed that patients with metabolic syndrome had significantly higher levels of depression and trevoga (Table 4).

**Table 1.** Clinical-demographic description of patients included in the study

Specification	With metabolic syndrome (n=76)	Metabolic syndrome disease (n=44)	p value
Age, year ( $m \pm SD$ )	63,7 $\pm$ 8,4	61,9 $\pm$ 9,1	0,27
Gender, n (%)			
- Men	41 (53,9)	25 (56,8)	0,85
- Women	35 (46,1)	19 (43,2)	0,85
Points on the NIHSS scale	9,8 $\pm$ 2,6	8,9 $\pm$ 2,3	0,06
Stroke localization, n (%)			
- Carotid Basin	51 (67,1)	26 (59,1)	0,42
- Vertebrobasillary Basin	25 (32,9)	18 (40,9)	0,42

**Table 2.** Risk factor prevalence

Risk factors	With metabolic syndrome (n=76)	Without metabolic syndrome (n=44)	p value
Arterial hypertension, n (%)	72 (94,7)	32 (72,7)	<0,001
Dyslipidemia, n (%)	69 (90,8)	18 (40,9)	<0,001
Diabetes mellitus, n (%)	39 (51,3)	7 (15,9)	<0,001
Smoking, n (%)	23 (30,3)	16 (36,4)	0,54
Ischemic heart disease, n (%)	31 (40,8)	15 (34,1)	0,56

**Table 3.** Results of assessment of cognitive functions

Test	7-10 days after stroke			3 months after stroke		
	With MS (n=76)	MS ppe (n=44)	p value	With MS (n=76)	MS you (n=44)	p value
MMSE, points	21,3±2,1	24,5±1,8	<0,01	23,1±2,4	26,4±1,5	<0,01
MoCA, score	19,8±1,9	22,7±1,7	<0,01	21,9±2,3	25,1±1,6	<0,01

**Table 4.** Psychoemotional status assessment results

Test	7-10 days after stroke			3 months after stroke		
	With MS (n=76)	MS you (n=44)	p value	With MS (n=76)	MS you (n=44)	p value
Beck Depression Scale, ball	18,7±3,2	12,5±2,8	<0,01	15,9±3,4	10,3±2,5	<0,01
Spielberg-Hanin scale (reactive trevoga), ball	48,6±4,3	38,2±3,9	<0,01	42,3±4,5	32,7±3,8	<0,01
Spielberg-Hanin scale (personal trevoga), ball	46,9±4,1	39,5±3,7	<0,01	44,1±4,3	36,2±3,6	<0,01

On the Beck Depression Scale, the average score in 7-10 days after stroke was 18.7±3.2 in patients with metabolic syndrome, and 12.5±2.8 in the control group ( $p<0.01$ ). On the Spielberg-Hanin scale, the reactive trevoga levels were 48.6±4.3 and 38.2±3.9 points ( $p<0.01$ ), respectively, while the personal trevoga levels were 46.9±4.1 and 39.5±3.7 points ( $p<0.01$ ).

Clinically significant levels of depression and trevoga ( $\geq 14$  on the Beck scale and  $\geq 46$  on the Spielberg-Hanin scale) were significantly higher in patients with metabolic syndrome compared to the control group. While clinically significant depression was found in 68.4% (52/76) of patients with metabolic syndrome, in the control group it was 31.8% (14/44) ( $p<0.01$ ). High levels of reactive trevogas were observed in 64.5% (49/76) and 29.5% (13/44) cases respectively ( $p<0.01$ ).

A significant correlation between depression and trevoga levels and cognitive functions was found (Table 5). The Beck Depression Scale was found to have a negative correlation with the results of MMSE and MoCA tests. That is, the more severe depression, the lower the cognitive functions.

**Table 5.** Correlation between depression, trevoga, and cognitive functions

Specification	MMSE	MoCA
Beck Depression Scale	$r = -0,62^*$	$r = -0,68^*$
Spielberg-Hanin scale (reactive trevoga)	$r = -0,58^*$	$r = -0,61^*$
Spielberg-Hanin scale (personal trevoga)	$r = -0,49^*$	$r = -0,53^*$

\* $p<0,01$

The risk of developing cognitive and psychoemotional disorders in patients with metabolic syndrome during the 3 months after stroke remained 2.4 times higher than in the control group ( $or=2.4$ ; 95% Di: 1.8-3.1).

The results of the study showed that cognitive and psychoemotional disorders are more severe in ischemic stroke, which develops against the background of metabolic syndrome. This can be influenced by a number of factors. First, the components of metabolic syndrome (hyperglycemia, dyslipidemia, arterial hypertension) deepen the cerebrovascular

damage and disrupt micro- and macrosirculation [7]. Second, insulin resistance and endothelial dysfunction accelerate neurodegeneration processes [8].

## 4. Conclusions

In ischemic stroke, which develops against the background of metabolic syndrome, cognitive disorders are significantly more severe (21.3±2.1 points on the MMSE scale, 19.8±1.9 points on the MoCA test). Even in the 3-month post-stroke period, patients with metabolic syndrome have a high level of cognitive impairment, and this is observed in 61.8% of patients. The MoCA test has been found to be more sensitive to MMSE in detecting mild post-stroke cognitive impairment, especially when evaluating performance functions. In patients with metabolic syndrome, clinically significant depression in the post-stroke period (68.4% of cases) and high levels of trevoga (64.5% of cases) are significantly more common compared to the control group. There is a direct relationship between depression and trevoga levels and the severity of cognitive impairment ( $r = -0.62$  to  $-0.68$ ;  $p<0.01$ ). Post-stroke depression was of a persistent nature and no complete regression was observed for 3 months, indicating the need for long-term psychological support.

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