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STROKE SEVERITY PREDICTION IN ADULTS POSTPONED BY COVID-19

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ABOUT ARTICLE

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Abstract: This article discusses the stroke severity prediction in adults postponed by Covid-19. Publications devoted to the topic of stroke against the background of coronavirus infection began to appear in the literature, but they are few in number and, as a rule, reflect a narrow range of this problem.

INTRODUCTION

Patients with major non-communicable diseases, namely strokes (strokes, hypertensive cerebral crises, transient ischemic attacks), arterial hypertension, myocardial infarction, diabetes mellitus, chronic respiratory diseases (COPD), oncological, mental illness according to leading organizations such as the American Heart Association, World Stroke Organization, European Stroke Organization, are now at risk of inadequate access to immediate medical care for profile pathologies, as well as the incidence of complications in case of infection with COVID-19 [2].

The "Consensus for the Prevention and Treatment of Coronavirus Disease (COVID-19) for Neurologists" provides data that among patients with SARS-CoV-2 infection, strokes developed in the majority of middle-aged and elderly patients, especially in critically ill patients [6].

Many of these patients already had other cerebrovascular risk factors such as hypertension, diabetes mellitus, hyperlipidemia, smoking, or a history of stroke. However, according to Mao and colleagues, in some patients, coronavirus infection may debut precisely with symptoms of a stroke [6].

Publications devoted to the topic of stroke against the background of coronavirus infection began to appear in the literature, but they are few in number and, as a rule, reflect a narrow range of this problem [5].

Based on the current situation, the need for a full-fledged dynamic study of the state of cerebral hemodynamics in terms of the relationship of these indicators with the results of neuro-immunological examinations and neuroimaging data, as well as determining the effect of cerebral blood flow reserves, as a parameter of functional plasticity of cerebral hemodynamics in patients with stroke against the background of COVID-19, is beyond doubt and definitely relevant from the point of view of practical neurology.

Studies are ongoing to study anticoagulant and antiplatelet therapy in the aspect of prevention of thrombotic complications, including CVT and IS, which has the potential to reduce morbidity and mortality in patients with severe COVID-19 [3].

Prevention of COVID-dependent stroke is based on the use of anticoagulants and antiplatelet agents, the appropriateness of prescribing them is determined by the severity of the disease and biomarkers of thrombus formation. Currently, anticoagulant prophylaxis for COVID-19 is carried out with enoxaparin, heparin, rivaroxaban, fondaparinux, and antiplatelet prophylaxis with acetysalicylic acid, clopidogrel and dipyridamole [5].

To date, according to a review of the literature, there is no consensus regarding anticoagulant and antiplatelet prevention of cerebrovascular complications in COVID-19 [3].

Purpose of the study. Develop a scale for predicting the severity of stroke in adults with COVID-19.

Material and research methods. The presented research work was carried out at the Department of Nervous Diseases of the Regional Vascular Center at the Federal State Budgetary Institution NSO City Clinical Hospital № 1 in the period from 2020 to 2022. Based on international criteria, we diagnosed CVA as “focal or diffuse impairment of brain function of cerebrovascular origin lasting at least 24 hours or leading to death in a shorter period of time” [3].

Table 1

Distribution of subjects by groups

Groups	gender index	men		women		total	
		n	%	n	%	n	%
main group (MG)	1,46*	98	59,4%*	67	40,6%*	165	61,1%
comparison group (GS)	1,18	46	54,1%	39	45,9%	85	31,5%
control group (CG)	1,00	10	50,0%	10	50,0%	20	7,4%
Total	1,33	154	57,0%	116	43,0%	270	100,0%

Note: *- reliability p>0.05 between MG and GS.

The diagnosis of COVID-19 was made according to the "Temporary recommendations for the management of patients infected with a new coronavirus infection COVID-19" of the Ministry of Health of the Republic of Uzbekistan, version 8 [1]. This paper indicates that the World Health Organization (WHO) in January 2020 updated the ICD-10 section "Codes for use in emergencies" by adding a special code for COVID-19 - U07.1 [6].

A selection of patients was made according to the selection criteria with ischemic stroke (IS): the main group (MG) - 165 patients with IS + COVID-19 (98 men and 67 women), mean age 52.4±10.9 years and a comparison group (CS) – 85 patients with IS without COVID-19 (46 men and 39 women), mean age 65.9±4.8 years. The control group (CG) included relatively healthy individuals (n=20; mean age 52.4±6.5 years; gender index 1.0:1.0) (Table 1).

We were guided by the fact that there are a significant number of multidirectional publications in the literature regarding views on the pathogenesis and clinic of neurological complications in COVID-19, and in order to concretize the study, we analyzed only cases with ischemic stroke in our work.

Concomitant and comorbid diseases were assessed by us using the Charlson IC and the CIRS scale. The severity of IS was assessed using the NIHSS stroke scale, according to which up to 8 points - mild IS, 9-12 points - moderate, 13-15 points - severe, 16-34 points - extremely severe IS.

We assessed the outcomes of IS according to the Rankin scale (SR): 0-3 points were received by patients with the ability to move independently, 4-5 points - without the ability to move independently, 6 points - death.

The prognostic matrix was also based on the results of the autonomic blood circulation index (VBCI), based on the blood pressure and heart rate of patients. Systolic (SBP) and diastolic blood pressure (DBP) were studied in both upper limbs of patients lying at rest on their backs, taking as true the maximum values of SBP and DBP, heart rate was simultaneously calculated in 1 min. These studies were carried out with a validated automatic tonometer "AND UA 767" (Japan). In some patients, the described indicators were recorded from tracking monitors.

Table 2.

Characterization of the predominant autonomic tone of the cardiovascular system based on a certain value of the VPC.

Vegetative tone	The value of the MIC, c.u
Severe sympathicotonia	2,0 and higher
Severe sympathicotonia	1,56–2,0
Moderately expre. sympathicotonia	1,30–1,55
Mild sympathicotonia	1,06–1,29
Eitonia	0,95–1,05
Mild vagotonia	0,94–0,80
Moderately pronounced vagotonia	0,79–0,65
Severe vagotonia	0,64–0,50
Pronounced vagotonia	0,5

The parameters of systemic hemodynamics determined by us allowed us to calculate the state of autonomic tone (VT): the Kerdo autonomic index (CI) and VPC using special questionnaires and tables of A.M. Wayne [3], based on objective indicators of hemodynamics and VT: "Kerdo index (IC), minute volume of blood flow calculated by an indirect method, heart rate variability, variational pulsometry, intersystem ratios and the Hildebrant coefficient" [3].

BT was based on the IC calculated by the formula:

IC = (1 – DBP/HR)•100,

where IC is the Kerdo index; DBP, diastolic blood pressure; HR - heart rate.

A positive IC indicates the predominance of the sympathetic, and a negative one indicates the predominance of the parasympathetic BT.

Determination of the VPK quantitatively characterizes the BT of the CCC, allows you to track dynamic changes, stating the clinical symptoms of the patient. The predominance of sympathetic influence is characterized by an increase (increase) in the stroke and minute volumes of the heart.

VPK combines several indicators of systemic blood flow - heart rate, SBP and pulse pressure (PAP) - the difference between SBP and DBP. The VPK was calculated using the formula:

VPK = k * (HR / 60 мин.-1)2 * PP/SBP,

Where k is an empirical coefficient equal to 2s2 (2 is a correction factor * 1 sec 2).

VPK with the predominance of sympathetic or parasympathetic influence of the ANS was measured in conventional units (c.u.). Normal BT (euthonia) has a MIC from 0.95 to 1.05 c.u. (Table 2).

Statistical processing of the results of clinical and instrumental studies of our patients was carried out using the methods of variation statistics in the Microsoft Office Excel-2019 software package with the determination of the mean and mean arithmetic errors by the method of moments (M ± m), standard deviation (□).

Statistical significance of the results was assessed using Student's test of significance (t) for parametric distribution and Fisher's test (F) for nonparametric data distribution. Differences were considered significant at 95% confidence interval (P≤0.05).

Research results. We divided all the studied patients into 4 categories of the NIHSS scale, depending on the severity of IS, according to which up to 8 points - mild IS, 9-12 points - moderate, 13-15 points - severe, 16-34 points - extremely severe course of IS (Table 3).

Table 3.

Severity of neurological deficit in patients with different subtypes of IS, NIHSS scale

IS subtypes	n	NIHSS scale							
		Light		average		Heavy		extreme severity	
AT	67	4	6,0%	16	23,9%	30	44,8%	17	25,4%
CE	55	2	3,6%	10	18,2%	23	41,8%	20	36,4%
LI	58	46	100,0%	12	26,1%	0	0,0%	0	0,0%
CG	19	5	26,3%	9	47,4%	2	10,5%	3	15,8%
NP	51	10	19,6%	14	27,5%	20	39,2%	7	13,7%
TOTAL	250	67	26,8%	61	24,4%	75	30,0%	47	18,8%

Table 3 shows that severe and extreme severity of IS at admission was significantly more common in atherothrombotic (AT) and cardioembolic (CE) subtypes of IS.

Severe severity according to the NIHSS scale was detected in 43.3% of patients with AT and 40.0% with CE, extreme severity was observed in 25.4% with AT and 36.4% with CE. Thus, severe IS at admission was detected in 36.6% of all examined patients and in 73.8% of patients with AT and CE subtypes of IS.

In this connection, only these two subtypes of IS were taken for further research in order to predict the severity of IS (Table 4).

Table 4 shows that severe forms of IS were significantly more common in the MG. So, in AT, severe and extreme severity according to the NIHSS scale occurred in 47.6% and 26.2% of cases, respectively, and in CE, these forms of IS severity occurred in 41.7% and 38.9% of cases.

It should be noted that in MG, a severe degree was more common in patients with AT subtype IS, and extremely severe in patients with CE subtype IS (47.6% versus 41.7% and 26.2% versus 38.9%, respectively).

In MG, severe and extremely severe degrees of IS were more often observed in patients with CE subtype IS - 42.1% and 31.6%, respectively, with AT subtype IS, these degrees of severity were less common (significance was detected at extreme severity ($p<0.005$) - 40.0% and 24.0%, respectively (Table 4).

Table 4.

The severity of neurological deficit in patients with AT and CE subtypes of NIHSS IS depending on the status of COVID-19

Groups	IS subtypes	n	NIHSS scale							
			light		average		heavy		extreme severity	
MG, n=78	AT	42	1	2,4%	10	23,8%	20	47,6%	11	26,2%
	CE	36	1	2,8%	6	16,7%	15	41,7%	14	38,9%
CG, n=44	AT	25	3	12,0%	6	24,0%	10	40,0%	6	24,0%
	CE	19	1	5,3%	4	21,1%	8	42,1%	6	31,6%
total, n=122	AT	67	4	6,0%	16	23,9%	30	44,8%	17	25,4%
	CE	55	2	3,6%	10	18,2%	23	41,8%	20	36,4%

The state of moderate severity was observed more often in CE subtype IS in both groups compared with the same indicators in AT subtype IS - 24.0% (CG) and 23.8% (MG), 21.1% (CG) and 16.7 % (MG), respectively (Table 4).

Due to the fact that AT and (CE) subtypes of IS had a high score on the NIHSS scale (Table 4), patients with these subtypes of IS were included in the sample at a later stage of the study and were divided by us into 3 categories depending on the outcome of the stroke, which was assessed on the Rankin scale in points on the 21st day:

Category 1, which received a score from 0 to 3 on the Rankin scale, they could already move independently and serve themselves, only 13.1% of patients, and in group I this indicator was significantly lower compared to group II - 11.5 % and 15.9%, respectively (Table 5).

Category 2 (56.6%) - patients who scored 4-5 points on the Rankin scale (could not move independently and needed care), in group I there were 56.4% of such patients, in group II - 56.8%,

Category 3 - patients who died in the acute period of IS (Rankin - 6 points) significantly prevailed in group I - 32.1%, while in group II - 27.3% ($p < 0.05$).

Table 5

IS outcomes in groups on the Rankin scale (points)

Groups	Rankin scale (points)			p<
	0-3 (1)	4--5 (2)	6 (3)	

	n	%	n	%	n	%	1--2	2--3	1--3
MG, n=78	9	11,5%	44	56,4%	25	32,1%	0,005	0,005	0,05
CG, n=44	7	15,9%	25	56,8%	12	27,3%	0,005	0,005	0,05
total, n=122	16	13,1%	69	56,6%	37	30,3%	0,005	0,005	0,005

Note: * - significance of differences p<0.005 between MG and CG.

We stated a statistically significant difference (p<0.05) according to Charlson IC and CIRS, VPK and NIHSS scale with Rankin scale scores in the most acute period (day 1 of IS) (Table 1).

Table 6 shows the dynamics of the studied parameters by categories of patients with IS on the 7th and 14th day of the acute period.

Table 6.

Dynamics of indicators of Charlson IC, CIRS and NIHSS scales, VPK

Indicators	**terms**	**Rankin scale (points)**		
		0-3	**4---5**	**6**
IC Charlesson		3,1±2,4	6,2±2,8	8,1±1,9
CIRS scale		3,9+1,2	5,6+2,1	10,3+1,8
VPK	1st day	1,26±0,12	1,38±0,09	**1,82±0,8**
	7th day	1,16±0,06	1,27±0,05	**2,13±0,4**
	14th day	1,09±0,05	1,13±0,07	1,45±0,08
NIHSS (points)	1st day	3,8+1,4	12,3+4,7	23,4+6,1
	7th day	3,1+1,7	10,3+3,8	25,6+7,2
	14th day	2,4+1,1	8,2+3,4	31,8+5,7

VPK at admission in patients who died in the acute period (according to SR 6 points) was characterized by a clear predominance of sympathicotonia (1.86 c.u.), which became an even more predominant condition on the 7th day (2.32 c.u.), remaining somewhat expressed to death (1.45 c.u.).

A decrease in VPK against the background of high rates according to NIYSS and the Rankin scale indicates the depletion of the autonomic nervous system against the background of prolonged pronounced sympathicotonia (Table 6).

VPK in patients with moderate IS according to SR corresponded to a moderately pronounced sympathicotonia (1.38 c.u.) and in dynamics, on the 7th and 14th day of hospitalization, quantitatively decreased - 1.27 and 1.13 c.u. e. respectively.

Table 7.

IS Severity Prediction Scale

Sign	units	points
age, years	>70	0
	<70	1
stroke severity in points, measured by the United States National Institutes of Health Scale (NIHSS)	5--11	1
	12--23	2
	>24	3
Charlson Comorbidity Index	<5	1
	6<12	2
	13<23	3
Vegetative indicator of blood circulation VPK	>1,56	1
Subtypes of IS (Atherothrombotic and Cardioembolic)		1
History of COVID-19		1

Low risk	**1—4**
Medium Risk	**5--10**
High risk	**11--16**

Thus, against the background of stabilization of vegetative homeostasis, positive neurological dynamics occurred. This category of patients also had an average CI on the Charlson and CIRS scales of 6.2 and 5.6, respectively. In patients with a good outcome of IS on the Rankin scale, VPK during hospitalization was characterized by moderate sympathicotonia (1.26 c.u.), on the 7th and 14th days of inpatient treatment, VPK was 1.16 and 1.09 c.u. e. respectively. In this category of patients, Charlson IC scores and CIRS scores were 3.1 and 3.9, respectively (with significant intergroup differences) (Table 6).

Thus, a direct correlation was found between the severity of IS according to NIHSS and its outcome according to SR with the severity of comorbid diseases according to the Charlson IC and the CIRS scale. Statistical analysis of multiple regression with the gradual removal of predictor variables that affect the outcome of IS stated the correlation of scores according to the Charlson IC, according to the NIHSS scale and c.u. VPK (r=0.7221, r=0.5214 and r=3308, respectively; p=0.0031).

The conducted ROC analysis demonstrated sufficient specificity and sensitivity of such variables as age, CI according to Charlson, VPK, scores according to the NIHSS scale and subtype of IS relative to the correlated scores of SR:

- age, years;
- stroke severity in NIHSS scores;
- IC Charlson and scores on the CIRS scale;
- AT and CE subtypes of IS;

- VPK, ye;
- History of COVID-19.

Based on the calculations, we formed the Scale for assessing the severity of IS (Table 7), from which it can be seen that the only indicator that can be changed is the TPC, and this will make it possible to prevent severe outcomes of IS.

CONCLUSION

Our study found a direct correlation between the severity of IS according to NIHSS and its outcome according to SR with the severity of comorbid diseases according to the Charlson IC and the CIRS scale. Statistical analysis of multiple regression with the gradual removal of predictor variables that affect the outcome of IS stated the correlation of scores according to the Charlson IC, according to the NIHSS scale and c.u. VPK (r=0.7221, r=0.5214 and r=3308, respectively; p=0.0031). Based on the calculations, we have formed a scale for assessing the severity of IS, from which it can be seen that the indicator that can be changed is only the VPK, and this will make it possible to prevent severe outcomes of IS.

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