Statodynamic exercises in self-rehabilitation of post-stroke patients at home

UDC 796.077-056.266

PhD, Associate Professor **I.E. Yudenko**[1]
[1]Surgut State University, Surgut

Corresponding author: yudenko_ir@mail.ru

Abstract

Objective of the study was to evaluate the effectiveness of using statodynamic physical exercises in the self-rehabilitation of persons who have suffered a cerebral stroke.

Methods and structure of the study. Subject to the study were a total of 19 persons (mean age - 58.5±7.3 years) who suffered a cerebral stroke and underwent a rehabilitation course at the Department of Neuro-Rehabilitation of the Surgut Clinical Psychoneurological Hospital. To determine whether the developed complex of statodynamic exercises is effective, we measured the functional indicators (heart rate, blood pressure), tolerance to hypoxia using Stange and Gen he's tests, as well as the parameters characterizing the efficiency of physical rehabilitation: goniometry and dynamometry of the paretic arm, the level of muscle spasticity on the Ashworth Scale.

Results and conclusions. The study findings indicate that it is appropriate to use the developed complex of statodynamic exercises in the post-stroke rehabilitation. There were statistically significant changes (at $p<0.05$) in most functional indicators, as well as in the parameters characterizing the efficiency of physical rehabilitation, which significantly improved the quality of everyday social and household activities of the patients.

Keywords: *patients, cerebral stroke, statodynamic exercises, physical rehabilitation indices, functional indicators.*

Background. The overall incidence of cerebrovascular diseases makes acute cerebrovascular accident (ACVA) one of the decisive factors of high incapacitation of the population. As a result, up to 80% of patients become weak. In addition, the current pandemic has negatively affected the health status of the population, in particular, that of the inhabitants of the Khanty-Mansi Autonomous Region - Yugra.

It is noteworthy that the medical community has observed a rising incidence of vascular disorders due to the Covid-19 pandemic. This disease leads to intermuscular coordination disorders [1]. As a result of the long-term maintenance of malposition, the muscular-ligamentous apparatus of those exposed to the virus in the past develops persistent secondary disorders. Patients who have acquired a diminished motor function of the arm become noticeably limited in their daily social and household activities [1, 3, 4]. Therefore, in addition to the restoration of the arm movement, a key condition of rehabilitation is a return to domestic, labor, and, where possible, professional activities.

A scientifically based system of self-rehabilitation at home is economically advantageous for society, as it prolongs patients' household and social activities by reducing the periods of temporary incapacity to work and preventing adverse outcomes and disability. The main task of self-rehabilitation at home as such is to restore physical and somatic health, overall and special working capacity of patients [4].

The urgency of the issue necessitates the elaboration of self-rehabilitation measures, including statodynamic physical exercise.

The inclusion of statodynamic exercises in the rehabilitation course for post-stroke primarily affects the body reaction to muscle work. The use of statodynamic exercises in the rehabilitation of patients after an acute cerebrovascular accident makes it possible to perform any physical exercise softly and spring-like [2, 5]. At the same time, the trainees' heart rate (hereinafter HR) does not change, while the blood pressure (BP) rates increase less significantly than during the performance of exercises in the dynamic mode [5, 6].

Objective of the study was to evaluate the effectiveness of using statodynamic physical exercises in the self-rehabilitation of persons who have suffered a cerebral stroke.

Methods and structure of the study. The study was carried out at the Department of Neuro-Rehabilitation of the State Budgetary Institution of KhMAO-Yugra "The Surgut Clinical Psychoneurological Hospital". Subject to the study were a total of 19 post-stroke patients (mean age - 58.5±7.3). The rehabilitated subjects made up the Experimental Group (EG, n=10). They performed a complex of statodynamic exercises for upper limbs, developed together with the doctors in therapeutic physical culture. The Control Group (CG, n=9) subjects performed only the exercises recommended to them upon discharge. So did the EG ones. The controlling influence lasted for 22 weeks.

To determine whether the developed complex of statodynamic exercises is effective, we measured the functional indicators (HR, BP), tolerance to hypoxia in Stange and Gen he's tests, as well as the parameters characterizing the efficiency of physical rehabilitation: goniometry and dynamometry of the paretic arm, the level of muscle spasticity on the Ashworth Scale.

The methodically correct application of statodynamic exercises implies ease of use, does not cause high fatigue, does not injure trainees. Each

Table 1. *Suggested list of statodynamic exercises*

Initial position	Content of routine	Dosing
I.P. sitting on a chair, arm down by the sides	Side bends with the stretched/ bent arms until the onset of fatigue. In all directions, swaying a bit with the minimal (possible) amplitude.	until the onset of fatigue
I.P. sitting on a chair (standing), hands on hips	Backbends on count 8 (swaying a bit)	4-6 reps
I.P. sitting on a chair (standing), arms sideways, back of the hands towards oneself.	Alternate arm circling backwards with average amplitude.	4-6 reps
I.P. sitting, arms sideways, wrist-lock downwards	Arm circling forward with average amplitude (forcefully and tensely).	until the onset of fatigue
I.P. sitting, arms sideways	Raising tensed straight arms	4-6 reps (until the onset of fatigue)
Same I.P.	Lowering tensed straight arms	4-6 reps (until the onset of fatigue)
I.P. sitting (standing), arms forward, sideways, bent at the elbows, fingers clenched	Forceful fist adduction to the chest (a light weight may be used)	4-6 reps
I.P. sitting (standing), arms sideways	1 – hands backward, palms outward (pronation); 2 – hands backward, palms downward; 3 – hands backward, palms outward (supination); 4 – hands backward, palms downward.	until the onset of fatigue
I.P. sitting (standing)	Spreading fingers using a rubber band	until the onset of fatigue
I.P. sitting (standing)	Lifting and/or holding a disk (different weights) using a «pincer grip» (closing the thumb and the palm)	2-6 reps (until the onset of fatigue)

Table 2. *Test rates in EG and CG before and after self-rehabilitation course at home (M±δ)*

Indicators	EG (n=10)		CG (n=9)	
	Before	After	Before	After
Dynamometry of the paretic arm, kg	13,9±11,4	16,4±12,7	14,1±12,0	15,8±12,1
AmM in radiocarpal joint, degrees	16,2±6,9	30,2±9,4*	12,4±4,1	14,5±3,9#
AmM in elbow joint, degrees	52,5±5,2	71,7±5,1*	58,8±6,4	64,0±5,2
AmM in shoulder joint, degrees	152,5±11,3	176,0±5,8*	155,3±6,8	160,9±5,5#
Level of arm spasticity on the Ashworth Scale, points	3,0±0,6	1,7±0,5*	3,0±0	2,3±0,5#

* statistically significant changes in EG at p<0.05; statistically significant changes as opposed to CG at p<0.05.

Table 3. *Functional indicators in EG and CG patients before and after self-rehabilitation course at home (M±δ)*

Indicators	EG (n=10)		CG (n=9)	
	Before	After	Before	After
SBP, mmHg	149,1±14,6	119,1±14,3*	142,9±15,3	131,1±14,6
DBP, mmHg	86,5±7,5	72,5±6,0*	82,2±7,1	78,6±6,8
HR, bpm	96,6±8,6	80,5±7,8*	89,6±8,4	80,5±8,9
Stange's test, sec	39,4±17,7	47,5±13,2	37,5±16,8	43,2±13,1
Genche's test, sec	23,3±9,9	29,7±9,6	26,9±10,9	28,9±10,2

* statistically significant changes in EG at p<0.05

exercise, distinguished by the features of the movement structure, no matter how small, is characterized by the specificity of its effect on the body [5, 6]. As part of this study, we proposed statodynamic exercises that can be performed at home and are aimed to strengthen muscles. Table 1 lists the exercises in the statodynamic mode (resistance and non-resistance ones). All statodynamic exercises are performed without a breathhold. If necessary, the trainees are actively assisted (spotting and correction) by their relatives.

Results and discussion. The test results are presented in Tables 2 and 3. Before the experiment, the average amplitude of movement (AmM) of the radiocarpal joint was 16.2°±6.9, of the elbow joint - 52.5°±5.2, and of the shoulder joint - 152.5°±11.3. The level of spasticity on the Ashworth Scale before the experiment was 3.0±0.6 points. The hand dynamometry before the experiment was 13.9±11.4 kg. After the experiment, the test rates changed as follows: the amplitude of movement of the radiocarpal joint improved to 30.2°±9.4, of the elbow joint - to 71.7°±5.1, and of the shoulder joint - to 176.0°±5.8. The level of spasticity on the Ashworth Scale fell to 1.7±0.5 points. All the results obtained in EG after the experiment changed statistically significantly at p<0.05 except for the dynamometric indices.

In our view, this was due to the fact that, in most cases, it was the working hand that was a paretic one. It should be noted, however, that the average hand dynamometry rate increased by 3 kilograms - to 16.4±12.7 kg. The data obtained in CG indicated changes, though not statistically significant. In addition, at the end of the experiment, we found that in the 3 tests, the results differed significantly (at p<0.05) between the two groups of patients - EG and CG. These were the indicators of mobility in the radiocarpal and elbow joints, as well as the level of spasticity on the Ashworth Scale, which improved as opposed to the same indicators in CG.

At the beginning of the study (Table 3), the mean value of systolic blood pressure (SBP) in EG was 149.1±14.6 mmHg and that of diastolic blood pressure (DBP) - 86.5±7.5 mmHg, HR - 96.6±8.6 bpm. Before the experiment, the Stange' test rate was 39.4±17.7 sec and the Genche's test rate was 23.3±9.9 sec.

After the experiment, the systolic blood pressure rates in the EG patients reduced to 119.1±14.3 mmHg. There was also a decrease in the diastolic blood pressure rates - to 72.5±6.0 mmHg, and HR - to 80.5±7.8 bpm. The Stange's test rates improved to 47.5±13.2 sec. It should be emphasized that this decrease was also statistically significant (p<0.05). Changes in the Genche's test rates indicated an uptrend. There were functional changes in CG, too; however, by the end of the experiment there were no significant changes in this group's indicators.

Conclusions. Therefore, the chosen approach to the use of statodynamic exercises at home allows for the effective rehabilitation of the isolated, complex and purposeful arm movements.

The use of statodynamic exercises in the self-rehabilitation at home, as well as the extension of the range of the organizational and methodological conditions for their use in a medical institution, will

make physical rehabilitation more accessible and systematic in face-to-face handling of patient, who are able to continue the an active physical rehabilitation course after being discharged from the hospital, which, in turn, will significantly accelerate the restoration of the motor function of the upper limb.

References

1. Belova A.N., Shchepetova O.N. Guidelines for rehabilitation of patients with movement disorders. In 2 vol. V. 1. Moscow: Antidor publ.. 1998. 224 p.
2. Seluyanov V.N. Health-improving physical education technology. Moscow: SportAkademPress publ., 2001. 172 p.
3. Skvortsova V.I. Fundamentals of early rehabilitation of patients with acute cerebrovascular accident. Neurology teaching aid for medical students. Moscow: Litterra publ., 2006.
4. Chogovadze A.V.; Epifanov V.A. [ed.] Non-fixed changes in musculoskeletal system. Physical Therapy. Guide. Moscow: Meditsina publ., 1987. pp. 407 409.
5. Yudenko I.E. Hardware mechanotherapy for effective restoring of upper limbs performance in post-stroke patients. Interaction of spiritual and physical education in formation of harmoniously developed personality. Proc. IV International research-practical online conference. Slovyansk: Donbas State Pedagogical University publ., 2017. pp. 408–414.
6. Yudenko I.E. Organizational and methodological conditions of health-improving classes of special health group students diagnosed with neurocirculatory dystonia (case study of Surgut universities). PhD diss. abstract. Tyumen, 2002. 26 p.