

# Efficacy of Neurodynamic Method Complex Rehabilitation of Patients with Acute Cerebral Blood Circulation Disorder

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**Abstract** – The article presents the results of the proprioceptive neuromuscular facilitation in patients who have suffered a stroke. The use of the 4-week PNF course contributed to a significant increase in the motor index, which was accompanied by an increase in the volume of motion in the joints of the paretic limbs, a decrease in muscle tone, the formation of the correct step and the formation of the foot while walking.

**Keywords** – brain infarction, proprioceptive neuromuscular facilitation (PNF method)

## I. INTRODUCTION

Annual stroke mortality in Russia is one of the highest in the world. Stroke morbidity and mortality rates among people of working age in Russia have increased by more than 30 % over the past 10 years. The early 30-day death toll after a stroke is 34.6 %, and approximately half of those affected die within a year [4].

In addition to the alarming morbidity and mortality rates associated with acute cerebral circulation disorders, stroke is one of the leading causes of persistent disability, leading to severe disability and making self-care difficult inside home. By the first year, 2/3 of the stroke survivors had some kind of neurological deficit. By the end of the first year, only 25–30 % of stroke patients are completely independent of others [3, 11].

Lesions of the nervous system are one of the main causes of disability in patients with vascular brain disease, which largely determines the relevance of this neurological problem. It is especially important for stroke patients. In these cases, the process of rehabilitation is strongly influenced by the development of depression [1, 2, 6].

The frequent consequences of stroke are comorbid depressive disorders, with a prevalence of depressive disorders ranging from 25 to 79 % of cases (1; 12; 13).

The development of depressive syndrome is usually associated with strong psychologically traumatic effects

that result from a brain infarction. These processes significantly complicate recovery processes, which leads to a decrease in the activity of life and the inability to adapt to everyday life.

The purpose of the present study was to study the influence of non-medicamentous means of restorative therapy by means of the neurodynamic method "Kinesotherapy in medical-conductive rehabilitation of neurologic patients with motor disorders" (medical technology, author Isanova V.A., No. FS-2006/135, developed on the basis of the PNF method) on the restoration of impaired motor functions and correction of psycho-emotional disorders in patients who have undergone brain infarction in the early recovery period of rehabilitation.

## II. MATERIALS AND METHODS OF THE RESEARCH

The study involved 80 patients undergoing inpatient treatment. The criteria for inclusion in the study were: early recovery period of atherothrombotic brain infarction (IM), absence of acute and chronic infectious diseases, and patient consent.

The average age of patients was 47 years  $\pm$  2.2 years. Out of 80 patients, 32 were men (40 %) and 48 were women (60 %). All patients were divided into 2 groups by randomization method:

The experimental group (n=40) in the process of rehabilitation of which the neurodynamic method "Kinesotherapy in medical-conductive rehabilitation of neurological patients with motor disorders" was applied (medical technology, author Isanova V.A., No. FS-2006/135, developed on the basis of the PNF method). The number of men is 15 (37.5 %) and women 25 (62.5 %).

A control group (n=40), which included standardised therapeutic gymnastics courses in the rehabilitation process. The number of men was 17 (42.5 %) and women 23 (57.5 %).

Rehabilitation course was four weeks. The duration of kinesiotherapy classes ranged from 45 to 60 minutes, depending on the severity of movement disorders, daily. In the experimental group, classes by the neurodynamic method of kinesiotherapy were conducted strictly individually. Training by the neurodynamic method of kinesiotherapy was aimed at forming the correct step in walking, keeping the given position of body segments, reducing posture asymmetry, increasing the support function of the paretic leg. For this purpose, the methods of kinesiotherapy on rhythmic stabilization and controlled mobility in the initial lying position, sitting, in the knee-knuckle position and in the modified "bear" position were used [9].

In the control group, depending on the severity of motor disorders, exercise therapy was conducted both individually and in small groups. Classical method of physical training is a passive gymnastics isolated in each joint, together with the treatment of the position at the early stages of rehabilitation. After activation of the patient's condition and its stabilization, exercises were carried out for healthy limbs, breathing exercises, as well as exercises for para-titic limbs in isometric mode, light exercises with the help of hangers, exercises with slight dosed resistance [10, 14].

Various modified scales were used to assess the effectiveness of rehabilitation measures in the restoration of motor function:

- Motor functions were investigated according to the motion index scale (L.McPeak, 1996; Beucc M., 1986). The presence of movements in 10 joints of the affected limbs was assessed. The maximum sum of points was 50 [15].
- Ashworth's scale (Ashworth B., 1964) – to estimate the volume of movements depending on the level of muscle spasticity in the affected limbs.
- Bradstater test (Bradstater M. et.al., 1983) – for the assessment of walking disorders with a recorded distance of 20 m. [10].

The Hamilton Rating Scale for Depression (HDRS), which determines the degree of depression, was used to objectively assess psychoemotional state.

### III. RESULTS AND DISCUSSION

When analyzing the dynamics of indicators in both groups before and after the rehabilitation activities, it was revealed that their changes were unidirectional, but differed in terms of the degree of severity (tab. 1).

Based on the table, the muscle strength index of L.McPeak in both groups was almost identical at the beginning of the study. The total score on the presence of movements in 10 joints in these groups was 27 out of a maximum of 50. In the experimental group, after the rehabilitation measures, with the inclusion of the procedures of the neurodynamic method of kinesiotherapy (analogue of PNF), the index of motor movement increased to  $42 \pm 1.8$  points ( $p < 0.001$ ), an increase of 55 %. When, as in the control group, whose patients were

included in the standard LFK method of rehabilitation, the sum of points increased by 29 % with the index  $- 35 \pm 2.7$  points ( $p < 0.001$ ).

TABLE I. DYNAMIC CHARACTERISTICS OF MOTOR FUNCTION BEFORE AND AFTER REHABILITATION IN THE STUDY AND CONTROL GROUP

Indicators (scores)	The experimental group		Control group	
	before rehab.	after rehab.	before rehab.	after rehab.
Motion index (points)	$27 \pm 2,2$	$42 \pm 1,8^*$	$27 \pm 2,7$	$35 \pm 2,7^*$
Ashforth's Muscle Spasticity Scale	$3 \pm 0,2$	$1.3 \pm 0,14^*$	$3.1 \pm 0,19$	$1.7 \pm 0,16^*$
Bradstater test (m/s)	$0.22 \pm 0,05$	$0,46 \pm 0,04$	$0.22 \pm 0,05$	$0.35 \pm 0,03$

Thus, according to the data of the study of the dynamics of the movement indexes, in the experimental group the result was higher than in the control group by 29 %. The determining factor was the neurodynamic method of kinesiotherapy applied in the process of rehabilitation.

Most researchers, speaking about motor disorders, focus on spastic syndrome [5, 7, 8].

At the beginning of rehabilitation, the experimental and control groups showed a pronounced muscle spasticity, which was a consequence of significant abnormalities of motor functions –  $3 \pm 0.2$  and  $3.1 \pm 0.19$  points, respectively ( $p > 0.05$ ). In the kinesiotherapy program, both in the study and in the control group, exercises aimed at reducing muscle tone were included, which predetermines the prevention of contractures of muscles and joints, as well as increasing the volume of movements.

In the experimental group, whose patients were trained using the neurodynamic method of kinesiotherapy, which was based on techniques for the development of supraspinal motor control, the index of muscle spasticity, by the end of the study, significantly decreased by 56 % and reached  $1.3 \pm 0.14$  points ( $p < 0,05$ ). A slight increase in tone, felt when bending or straightening the limb segment, in the form of minor resistance at the end of the movement was observed in 30 subjects, the remaining 10 had a slight increase in tone in the form of resistance, arising after half the volume of movements.

The average score on the muscle spasticity scale, after rehabilitation, in the control group decreased to  $1.7 \pm 0.16$  ( $p < 0.05$ ), with an improvement of 45 %.

Of the 40 subjects in the control group who received kinesiotherapy according to the traditional regimen, 15 had achieved a slight increase in muscle tone with little resistance, 24 had a slight increase in muscle spasm, and a moderate muscle tone was determined in 1 person. Thus, analyzing the intergroup differences in the level of muscle tone, it can be revealed that in the experimental group, this figure was improved by 11 %, compared with the control group. This was facilitated by neurophysiological mechanisms of proprioceptive neuromuscular perforation,

which are the basis of neurodynamic method of kinesotherapy (analogue of PNF), increasing the reactions of paretic muscles to their active contraction.

In the evaluation of the walking function in the experimental group, the initial mean speed of movement was  $0.22 \pm 0.05$  m/s, 13 patients required special means of movement, 18 patients moved with a cane or with help from others. After rehabilitation, a reliable improvement of this indicator was revealed. Movement speed was  $0.46 \pm 0.04$  m/s ( $p < 0.01$ ), and non-mobile patients and patients requiring mobility support began to move independently.

In the control group, whose patients were trained according to the generally accepted scheme, the average speed of movement before rehabilitation was  $0.22 \pm 0.05$  m/s, and after rehabilitation the result was equal to  $0.35 \pm 0.03$  m/s ( $p < 0.05$ ), which indicates the dynamics of the results is 15 % lower than in the subject group. Among the non-mobile patients, only 4 out of 11 started to move around on their own, while the rest needed help in moving around.

The diagnosis of depression was made according to the criteria of the International Classification 10 revision (ICD-10). The survey was accompanied by Hamilton Depression Rating Scale (HDRS) testing. Patients with identified depression of varying degrees of severity were included in the study (see figure).

Prior to rehabilitation, depressive status in both groups was almost identical –  $19 \pm 1.4$  and  $19.4 \pm 1.39$ , indicating a severe degree of depression. After rehabilitation in the experimental group, whose patients underwent a course of neurodynamic kinesotherapy, the level of depression significantly decreased to  $11.9 \pm 1.5$  ( $p < 0,01$ ) points with an improvement of the result by 37 %. Patients of the control group, who were offered a course of kinesotherapy according to the standard scheme, also showed a positive result, but with the lowest indexes –  $16 \pm 1.1$  points ( $p < 0,01$ ). The result in this group improved only by 17 %.

#### IV. CONCLUSIONS

- The results of this study prove the efficacy of the neurodynamic method of kinesotherapy as a means of non-drug rehabilitation. In the process of

rehabilitation the increase in tolerance to physical activity, formation of active movements in the lower and upper extremities was noted, which allowed to increase considerably the level of life activity of patients and to be independent of others. High dynamics was shown by studies of locomotor activity of patients due to the increase in the volume of movements in the joints of the paretic limbs, decrease in muscle tone, formation of the correct step and setting the foot while walking.

- Analyzing the dynamics of indicators of depressive disorder level we can conclude that the chosen method of neurodynamic method of kinesotherapy perfectly copes with the task. The observed decrease in the severity of symptoms of depression after rehabilitation can be explained by the improvement in mood, confidence in one's own strength due to the positive results of the activities. It is also possible to observe the appearance of positive motivation for further rehabilitation procedures, which is an important factor for the activation of recovery neurodynamic processes and adaptation in the social environment.

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