ORIGINAL ARTICLE

CONTENTS

Functional rehabilitation of the upper limb after right-hemisphere stroke: evaluation of the effectiveness of methods

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ABSTRACT

Aim: To study the impact of physical and occupational therapies on upper limb function and the degree of limitations in patients with right-hemisphere ischemic stroke complicated by neglect.

Materials and Methods: The study involved 58 patients, including 29 females and 29 males. The patients had their first ischemic stroke in the right hemisphere of the brain and unilateral spatial neglect. The average age of the patients was 68.62±10.06 years. The patients were divided into the MG and the CG in 29 individuals. In order to assess the impact of upper limb impairment and the degree of limitations experienced by patients, we used the main section of the DASH questionnaire, which consisted of 30 questions.

Results: The recovery of the upper limb in patients in the MG was better than in the CG. The recovery of the upper limb in patients according to the DASH questionnaire in the CG improved by 22%, and in the MG by 43%. Thus, after six months of using rehabilitation programs in the CG and the MG, the recovery of upper limb activities occurred almost 2 times faster in the MG than in the CG.

Conclusions: Thus, the study confirmed the positive effect of a combined program of physical and occupational therapies conducted with MG patients on the sensorimotor recovery of the upper limb.

KEY WORDS: neglect, sensorimotor recovery, physical therapy, occupational therapy

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INTRODUCTION

Cerebrovascular diseases are the leading cause of disability in the world. 70–87% of patients develop motor disorders after a stroke, while 40–56% develop upper limb impairment, often with partial recovery due to the complexity of its structure [1, 2].

The obtained data indicate the importance of timely detection and rehabilitation of unilateral spatial neglect (USN) syndrome, which often affects the quality of upper limb (UL) recovery after stroke. Motor disorders of UL after injury to the right hemisphere are complicated by a decrease in its activity and the development of inhibitory mechanisms, known as the phenomenon of unlearned use. The prognosis is worsened by disorders of spatial gnosis, orientation and attention, which complicates rehabilitation and reintegration to society. Neglect increases the duration of hospitalization and the risk of falling, significantly increases functional dependence and decreases the quality of life of the patient and their environment. Rehabilitation is complicated by anosognosia, which negatively affects the patients' awareness of their condition [3, 4].

Restoring the function of the UL in patients with USN should include measures to activate the limb in everyday life, normalize muscle tone, improve proprioceptive sensitivity, restore balance, as well as train short-term memory and attention. The success of the process depends on neuroplasticity, conscious involvement, memory, executive functions and the visual analyser [5, 6].

Despite various treatment attempts, including behavioral and motor methods, there is no consensus on their effectiveness [7]. Physical therapy focuses on the performance of exercises that contribute to the gradual restoration of motor control, and the improvement of balance using individual programs of safe activity. Occupational therapy includes functional activity training methods aimed at improving the ability to perform activities and integrate into the social environment, with

an emphasis on adaptive techniques and technologies. However, innovative approaches, such as the use of robotic devices, virtual reality simulation systems and biofeedback, are not available in most rehabilitation departments. Therefore, greater emphasis should be placed on multidisciplinary approach and active involvement of patients in the recovery process through the development of individual rehabilitation programs aimed at a faster and more sustainable return of motor functions and quality of life [8-11].

AIM

The aim of the research is to study the impact of physical and occupational therapies on upper limb function and the degree of limitations in patients with right-hemisphere ischemic stroke complicated by neglect.

MATERIALS AND METHODS

The study involved 58 patients, including 29 females and 29 males who met all the program requirements. The patients had their first ischemic stroke in the right hemisphere of the brain and unilateral spatial neglect. The average age of the patients was 68.62±10.06 years. The patients were divided by randomized sampling into the main group (MG) (29 individuals) and the comparison group (CG) (29 individuals). The study was conducted on the basis of the Vascular Neurology Department of Uzhhorod City Multidisciplinary Clinical Hospital of Uzhhorod City Council.

Based on the obtained results and applying the Canadian Occupational Performance Measure (COPM), an intervention was developed for MG patients, taking into account the individual capabilities and needs of each patient. The Predict Recovery Potential (PREP2) algorithm was used to predict interventions aimed at restoring the upper limb. The COAST format was implemented for goal setting. The SOAP algorithm was used to plan therapy. Therapeutic exercises, elements of PNF therapy (scapular, upper limb patterns), constraint-induced movement therapy (CIMT), and dual tasks were used, combined with methods aimed at correcting neglect.

CG patients received a rehabilitation program that included PNF, balance training, occupational therapy intervention, and fine motor skills exercises. After three months, and in the case of the DASH scale, after six months, a repeated final examination was performed.

To assess the activity and participation of patients with neglect, we used the main section of the DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire, which consists of 30 questions related to the state of upper limb function [12]. 21 questions are devoted to the degree of difficulty in performing physical activities due to limitations in shoulder or hand function; 6 questions concern the severity of certain symptoms and 3 to social/role functions. The assessment of the results of the DASH questionnaire on upper limb movement disorders and the limitations was interpreted as follows:

- 0-20 points — minimum restrictions,
- 21-40 points — mild restrictions,
- 41-60 points — moderate restrictions,
- 61-80 points — significant restrictions,
- 81-100 points — severe dysfunction.

RESULTS

In order to assess the impact of upper limb impairment and the degree of limitations experienced by patients, we used the main section of the DASH questionnaire, which consisted of 30 questions. Data analysis is based on the main statistical characteristics of the sample obtained on 8-9th day after the stroke. According to the results of DASH, we found significant limitations in the use of the upper limb. The ±S indicators were 50.46±3.78 points, and the Me value (25%; 75%) was 50.70 (47.7; 53.7) points.

The average (50.46) and median (50.70) are almost the same, indicating a symmetrical distribution. The lack of significant deviations between the minimum and maximum and the low standard deviation indicate homogeneity of the sample. Most respondents demonstrate a moderate degree of dysfunction, concentrated in the range from 47.7 to 53.7.

These results may be due to low scores in the pain section, as 72.4% of patients scored 4 and 5 points.

The greatest difficulties that neglect patients experienced were caused by actions such as raising the upper limb (placing an object on a shelf above the head, washing and drying the hair, washing the back, etc.).

Actions requiring upper limb muscle strength (opening a can; pushing a heavy door; carrying a heavy object (over 4.5 kg)) were difficult for 53.4% of patients with neglect. 87.9% of patients could not even consider cooking or taking care of their apartment, garden or yard. All patients complained of the inability or difficulty performing actions related to moving various objects.

Analysis of the obtained DASH questionnaire scores before the start of the rehabilitation program in the CG and MG showed almost the same average values at the level of 50.8 (47.5; 54.3) points and 50.09 (48.3; 52.3) points, respectively, in both groups. Comparison of the CG and MG scores using the Mann-Whitney test ($p > 0.05$; U-test = 350, Z = 1.0808) confirms the absence

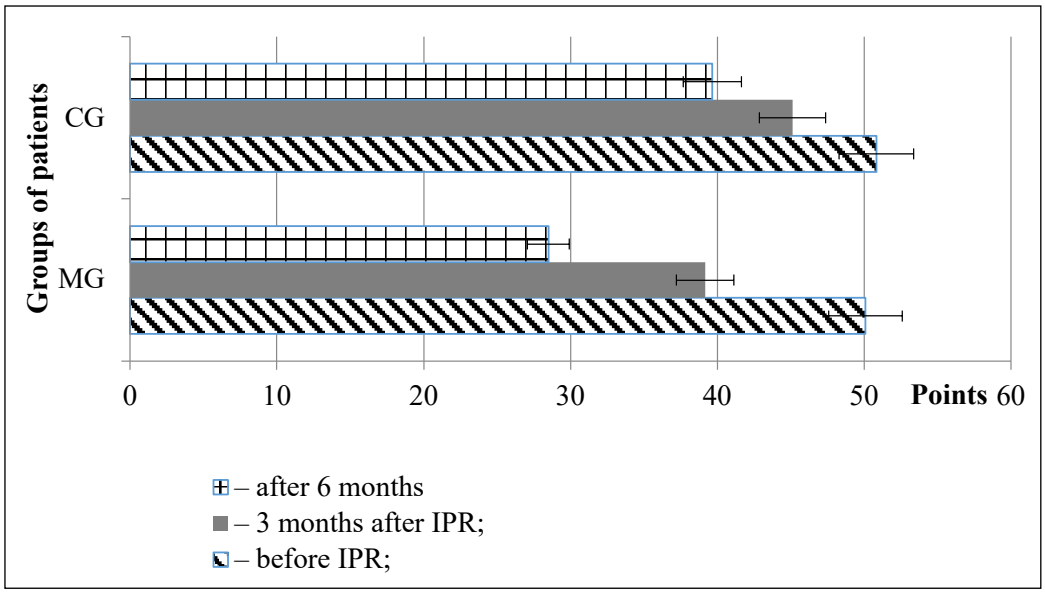

Fig. 1. Dynamics of recovery of upper limb mobility in the CG and MG according to the DASH questionnaire (CG = 29, MG = 29)
Picture taken by the authors

of a significant difference between them. Therefore, the disability of the upper limb in patients of these groups was the same at the beginning of the study.

The use of rehabilitation programs in both groups after 3 months brought certain changes in the condition of the upper limb in patients, which was reflected in the indicators of the second questionnaire in the CG and MG. In the comparison group, the average value was 45.21 (41.3; 47.3) points, while in the main group it was 39.17 (37.1; 41.3) points.

In the CG, the application of the T-test for dependent samples confirmed a significant difference ($p < 0.05$) after 3 months. The T value was 10.26, the difference in average values was 5.71 points at $\sigma = 2.99$. In the MG, a significant difference was also established ($p < 0.05$), where the T value was 12.19, the difference in average values was 10.91 points at $\sigma = 4.81$.

Comparison of upper limb disability scores in the CG and MG after 3 months revealed a significant difference between them according to the Mann-Whitney test ($p < 0.05$; U-test = 105, Z = 4.89). Thus, upper limb recovery in patients in the MG was better than in the CG. The scores in the CG group decreased by 11%, and in the MG group by 21%.

Measurement using the DASH questionnaire after six months showed certain improvement in the condition of the upper limb in the CG, in which the average value was 39.66 (38.5.3; 41.3) points, while in the MG it was 28.49 (26.3; 29.7) points.

After 6 months, CG and MG demonstrated significant changes in the upper limb indicators according to the DASH questionnaire. The application of the T-test for dependent samples confirmed a significant difference ($p < 0.05$). In the CG, the T value was 12.31, the difference in average values was 11.17 points at $\sigma = 4.88$. A significant difference was also established in the MG ($p < 0.05$), where the T value was 20.90, the difference in average values was 21.59 points at $\sigma = 5.56$, Fig.1.

Comparison of the upper limb disability indicators after 6 months revealed a significant difference between CG and MG according to the Mann-Whitney test ($p < 0.05$; U-test = 18.5, Z = 6.24). Thus, the recovery of the upper limb in patients in the MG was better than in the CG. The recovery of the upper limb in patients according to the DASH questionnaire in the CG improved by 22%, and in the MG by 43%. Thus, after six months of using rehabilitation programs in the CG and the MG, the recovery of upper limb activities occurred almost 2 times faster in the MG than in the CG. Thus, the MG patients restored the function of the upper limb much faster, showing the same results after 3 months as the CG patients after 6 months.

DISCUSSION

The 2006 Helsingborg Declaration [1314] set the goal for 2015 that all stroke patients in Europe should have access to a continuum of care: from acute stroke treatment to appropriate rehabilitation in specialized stroke units.

Rehabilitation has been defined by the WHO as "a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment" [4, 14]. It is essential to enable individuals with functional limitations to remain in or return to their homes or communities, to live independently without external assistance, and to obtain education, employment, and participation in community life.

There are several promising directions in solving the problem of cerebral stroke:

— prevention [4];
— effective treatment in the acute period [15];
— maximum possible medical and social rehabilitation of people who have suffered cerebrovascular accidents [2], and prevention of repeated vascular disasters [16].

The literature on the third area, namely stroke rehabilitation, is extremely extensive [17]. Dozens of rehabilitation approaches have been studied in recent decades. However, it is sometimes difficult to track new interventions and determine their impact on stroke recovery.

Given the limited health care resources in low- and middle-income countries, effective rehabilitation strategies that can be realistically implemented in such settings are needed. Ekechukwu E.N.D. [3] conducted a systematic literature review (1996 studies, of which 347 (65.22%) of high quality) to identify pragmatic solutions and outcomes that can improve stroke recovery and quality of life for people who have had a stroke in low- and middle-income countries. Most of the innovative high-tech interventions, such as robotic therapy (95.24%), virtual reality (94.44%), transcranial direct current stimulation (78.95%), transcranial magnetic stimulation (88.0%) and functional electrical stimulation (85.00%), were conducted in high-income countries. Several traditional and low-cost interventions, such as constraint-induced movement therapy (CIMT), balance and aerobic exercises, which can be used in resource-limited settings, were found to be effective in enhance recovery in patients with stroke and improving their quality of life.

Early diagnosis and correction of neglect are extremely important for the reintegration of people after stroke to society. USN is unique among the consequences of stroke and affects thinking, mental, visual and sensory functions, and disrupts three-dimensional motor functions [18]. The study confirmed the data of Ungerstedt U. on cases of walking in a circle when trying to move forward, [19]; Riestra AR on turning errors in patients with neglect [20]; on the risk of falling, impaired perception of the vertical axis and safety problems in individuals who have suffered ischemic stroke in the right hemisphere of the brain [21]. This is extremely important, since people with spatial neglect run a sixfold higher risk of falls [22].

Recent studies suggest that USN may be caused by a disruption of the interhemispheric balance of the visual attention network. Based on this hypothesis, non-invasive brain stimulation (NIBS), such as repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS), is used in the rehabilitation of patients with neglect [23, 24]. However, these techniques are not widely used in our country, and therefore rehabilitation care should include available recovery methods with a gradual transition to more modern interventions.

The positive effect of including sensorimotor retraining in the developed IPR was confirmed by the study by Carlsson H, Lindgren 2022 [25], which showed that the SENSUPP protocol (sensory relearning of the upper limb) was a promising method for improving sensorimotor function after stroke. In a study of 15 patients (average age 59 years, > 6 months after stroke), the protocol that included sensory and motor training and home exercises during 5 weeks, was assessed as significant. Patients noted improvements in motor control and performance of daily activities, although performing home exercises was difficult due to lack of support, time and motivation. The intervention included repetitive practices, training in meaningful tasks and the use of feedback based on current neurobiological knowledge. Support from therapists and group classes contributed to a positive perception, while regular monitoring and keeping a diary are recommended to increase the effectiveness of home exercises.

According to the results of the study, the combination of occupational and physical therapies is one of the best means for the recovery of post-stroke patients. Occupational therapy has a positive effect on the degree of recovery of individual functions in patients, as well as on the level of their independence in performing all basic household activities. The rational use of occupational therapy accelerates the recovery of muscle strength, normal amplitude of movements in the joints, and coordination of movements [26].

CONCLUSIONS

Thus, the study confirmed the positive effect of a combined program of physical and occupational therapies conducted with MG patients on the sensorimotor recovery of the upper limb.

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CONFLICT OF INTEREST:
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