ASSESSMENT OF THE REHABILITATION PROGRAM FOR PATIENTS WITH STROKE - A PRELIMINARY STUDY

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Abstract: Cerebrovascular diseases are the leading cause of morbidity and mortality around the world, and Bulgaria is on one of the first places, which determines the great social significance of the problem. Stroke is a leading cause of functional impairment and reduced daily activity. There is an increase observed in the frequency and severity of these diseases, accompanied by severe functional deficits, disorders of independence in everyday activities and quality of life. It is essential for the functional recovery of stroke patients to conduct timely, gradual, and comprehensive rehabilitation in all phases of the recovery process. Rehabilitation measures should consider the degree of damage of the central nervous system, the motor deficit and the concomitant diseases.

Objective: To study the influence of the applied rehabilitation program on the motor recovery, the daily functional activity, and the quality of life in patients who have survived a stroke.

Materials and methods: The pilot study included 39 stroke patients with a mean age of $69.90 \pm (10.75)$. The patients were divided into three groups and inpatient rehabilitation was applied. The first group had a severe degree of motor deficit, the second group was with a moderate motor deficit and/or discoordination syndrome and the third group - with a mild deficit and/or coordination disorders. The rehabilitation program included positional treatment, breathing exercises, active and passive exercises including balance and coordination, massage, specialized techniques for neuromuscular rehabilitation, verticalization and walking training, training in daily life activities. Low-frequency current stimulations are used to reduce spasticity. For the pain syndrome - magnetic field, interference currents, therapeutic ultrasound, and thermotherapy. The achieved results were evaluated in two stages - before and after rehabilitation by: testing of motor function; Brunnstrom scale, coordination testing, locomotion, diadochokinesia, Barthel scale. SPSSv.25 was used for statistical processing. The statistical significance of the changes is p < 0.05.

Results: In the beginning of the rehabilitation, 18% of the patients were in first motor deficiency group, 28% - in second group, and in third group - 54% of them. After the completion of the rehabilitation program in the first group were 15%, in the second - 5%, and in the third - 80%. Significant improvement in motor function for the upper and lower limbs after rehabilitation p < 0.001 and the Brunnstrom scale for upper and lower limb p < 0.001 were observed. Reduction in spasticity from 28% to 18% of patients was observed, as well as reduced coordination dysmetria. The proportion of non-vertical patients decreased from 26% to 8%. The Bartel index p < 0.001 was significantly increased.

Conclusion: The application of a complex rehabilitation program leads to a reduction in the motor deficit and discoordination syndrome and improvement of the daily functional activity in the examined group of stroke patients. In order to better objectify the obtained results, it is necessary to continue the study, covering a larger number of patients.

Keywords: stroke, rehabilitation, quality of life, Brunnstrom scale Bartel index

1. INTRODUCTION

Cerebrovascular diseases (CVDs) are the leading cause of morbidity and mortality worldwide, and Bulgaria is on one of the first places, which determines the great social significance of this pathology (Milanov, Iv. & Stamenova P. (2020); Tsalta-Mladenov, M., & Andonova, S. (2021).). Cerebral infarction (CI) is a leading cause of functional impairment and reduced daily activity in the elderly population. Globally, the burden of stroke is expected to increase due to improved medical care (Tsalta-Mladenov M., Georgieva D., Andonova S. (2020)) and the aging of the population (Katan, M., & Luft, A. (2018)). Increase in frequency and severity of these diseases with strong functional deficits, disorders of daily independence and quality of life (QoL) in these patients is observed. According to Eurostat data published on the information portal of EU, Bulgaria has the worse demographic picture among the countries in the European Union. Rehabilitation of patients with CI is a process involving a variety of tools and interventions aimed at achieving optimal social integration of the individual. In these patients, the rehabilitation is a long process, requiring a variety of skills from different sectors, structures, and services, which are not limited to the field of healthcare (Giustini A. (2009)).

The optimal time to start with rehabilitation, its duration and intensity are determined by a doctor specializing in physical and rehabilitation medicine co-working with other specialists.

Early rehabilitation is a key element of stroke unit treatment, but there is no consensus on the definition of the term "early therapy". Many of the stroke complications are related to immobilization, and therefore early rehabilitation is a key point in treatment (De Wit L., Putman K., Dejaeger E., et al. (2005); De Wit L., Putman K., Schuback B., et al. (2007)).

The purpose of this article is to examine the effects of the applied rehabilitation program on motor recovery, everyday functional activity, and quality of life in patients who have experienced cerebral infarction.

2. MATERIALS AND METHODS

The pilot study included 39 patients after stroke (18 women and 21 men) with inpatient rehabilitation in the Physical Medicine Department applied. The inclusion criteria were presence of severe hemiparesis or paralysis, severe discoordination syndrome or severe imbalance. After functional testing, patients were divided into three groups:

- \checkmark first group patients with severe motor deficit,
- ✓ second group patients with moderate motor deficit and/or discoordination syndrome
- ✓ third group patients with a mild degree of motor deficit and/or coordination disorders, with fine and complex motor skills affected.

Patients with very limited rehabilitation potential due to concomitant diseases or a new acute accident, with general contraindications for rehabilitation, such as fever, coagulopathies, severe heart failure, neoplasms, specific lung diseases, were excluded from the study. The rehabilitation program was consistent with the general condition and phase of motor recovery. The program included positional treatment, breathing exercises, active and passive exercises to increase the volume of movement and strength in the affected limbs, therapeutic massage, specialized techniques for neuromuscular reeducation balance and coordination exercises, gradual verticalization and training in walking with/without walking aids, self-service training in daily living activities (ADL) and occupational therapy. Electrostimulations with low frequency currents, low intensity magnetic field (LIMF), Interference currents, therapeutic ultrasound and phonophoresis were applied. Thermotherapy and/or cryotherapy were also used. To evaluate the achieved therapeutic results the following methods were used:

- \checkmark motor function testing.
- ✓ functional recovery stage determination according to Brunnstrom scale,
- \checkmark coordination,
- ✓ locomotion testing (locomotor test),
- ✓ fine and complex motor skills diadochokinesia and
- ✓ testing of independence in activities of daily living (ADL) according to Barthel scale.

The Brunnstrom scale in six stages (0 to 5) was used to determine the stage of functional recovery, where at zero stage of recovery, the affected limbs show 0 degrees of movement. They are relaxed, heavy when lifting and passive movement. Muscular hypotension or mild initial signs of spasticity are observed, and in stage six spasticity is not detected by clinical examination. The patient can perform movements in all joints in full volume, in good coordination and in numerous combinations. He/she uses his/her sick hand in everyday life, his/her gait is good. Pathology in motor function, mainly in fine movements and coordination, is established only with careful observation.

The scores when testing motor activity are as follows: 0 - no movement; 1 - beginnings of movement; 2 - performs movement without reaching the final position; 3 - the end position is reached, but the movement is not automated; 4 - the tested movement is performed well, but it lacks speed, lightness, strength; 5 - the tested movement is performed as with the healthy limb.

For better verification and statistical processing of the results obtained in the testing of motor function and the stage of functional recovery according to Brunnstrom in cases where the signs "+" or "-" are used to the corresponding assessment, we used a numerical expression for quantitative assessment (for "+" 0.25 is added to the test score, and for "-" 0.25 is subtracted).

The Bartel scale or index (BI) is a widely used scale to determine daily functional activity and the ability to function independently in patients with a history of cerebral infarction. It includes ten elements: eating, bathing, dressing, using the bathroom, controlling the bladder and sphincter, walking, going down and upstairs. Scores are set from 0 to 5 points for each element, with a maximum score of 100 points. The higher the score, the greater the patient's functional independence. Result from 0-20 points shows complete dependence, 21-60 points - strong dependence, 61-90 points - moderate dependence and 91-99 points - mild dependence. The index also shows the need for help in everyday life. SPSSv.24 was used for statistical processing. The statistical significance of the changes is p < 0.05.

3. RESULTS

The pilot study included 39 patients who had experienced cerebral infarction with mean age of $69.90 \pm (10.75)$, including 18 women with mean age of $71.94 \pm (12.13)$ and 21 men with mean age of $68.53 \pm (9,57)$. The characteristics of the patients included in the Pilot study are presented in Table 1.

Table 1. Demographic characteristics of patients				
Total N (39)	Number of patients (n)	(%)		
Distribution by sex				
Male	21	54%		
Female	18	46%		
Distribution by place of residence				
City	29	74%		
Village	10	26%		
Distribution by educational level				
University	11	28%		
High School	15	39%		
Primary School	13	33%		

In the beginning of the treatment course, 7 (18%) of the patients were in the first group of motor impairment with strong motor deficiency, and lack of independent volitional motor activity and/or gait or it was possible only with an accompanying person and walking aid.

There were 11 (28%) patients in the second group of motor impairment. Motor deficit and/or discoordination syndrome were moderately affected, motor activity bore signs of volitional control and there were available (but difficult) active volitional movements, gait, and self-care; moderate to severe static and/or locomotor and/or dynamic ataxia was observed.

In the third group there were 21 (54%) patients, who had milder degrees of motor deficit and/or coordination disorders, with fine and complex movements affected, but motor activity was rich and diverse without primitive synergies, and spasticity was insignificant.

There were 22 (56%) patients with left hemiparesis and 17 (44%) patients with right hemiparesis. After completion of the rehabilitation program in the first group of motor deficits there were 6 (15%) patients, in the second group there were two patients (5%), and the third group, with mild motor impairments were 31 (80%) patients. The group dynamics by degree of motor impairment for the observed period is presented in Fig. 1.



Fig. 1 The group dynamics by degree of motor impairment for the observed period.

Testing of motor function Me (Range) for upper and lower limb before and after the period of complex rehabilitation shows dynamics in the obtained results for upper limb from 4.00 (0.00-4.00) to 4.75 (1.00-5.00), and for lower limb from 4.00 (0.00-4.25) to 4.75 (1.00-5.00). There is a significant difference in the motor function of the upper limb before and after therapy - Z = 8.937; p <0.001, as well as of the lower limb - Z = 8.989; p <0.001 In the dynamics of the results of the stage of functional recovery study according to Brunnstrom Me (Range) a statistically significant improvement was found for upper limb - Z = 8.734; p <0.001 from 4.00 (0.00-4.00) to 4.75 (1.00-5.00) and for lower limb - Z = 8.814; p <0.001 from 4.00 (0.00-4.25) to 4.75 (1.00-5.00). In the study group, for the upper limb, the maximum score in Brunnstrom test before rehabilitation was 4, while after rehabilitation 51%

of patients had a score between 5- and 5. In lower limb, the highest was the percentage (69%) of patients with grade 4, without any patients in stage 5, while after the physiotherapy 92% of patients had scores between 4 and 5, and 67% of them reached the maximum score between 5- and 5.

Regarding spasticity in the paretic limbs before the start of the therapeutic course, 28% of patients were spastic (15% with mild spasticity and 13% with strong muscle spasm) after treatment spasticity was found in 18%, of which 13% with mild and only 5% continued to have severe spasticity.

When testing the coordination of the patients, a tendency to decrease the dysmetria during the performance of the nose-finger and heel-knee test was established. The dynamics is presented in Fig. 2.

30 25 20 15 10 5					
0	Finger-nose Test before Rerehab	Finger-nose Test after Rehab	Heel-knee Test before Rehab	Heel-knee Test after Rehab	
Able	3	25	10	23	
Light Dysmetria	24	10	16	10	
Moderate Dysmetrya	3	0	2	0	
Not able	9	4	11	6	

Fig. 2 Dynamics in Finger–nose and Heel-knee test.

During the testing of diadochokinesia, a violation was observed in 56% of the patients (n = 22) admitted for rehabilitation. After the rehabilitation applied, this percentage was reduced to 23% (n = 9).

The study of statics showed that 26% of patients were not verticalized before the therapeutic course, and after it the relative share of these patients decreased to 8%. The dynamics is presented in Fig. 3.



Fig. 3 Dynamics in the study of statics

The data from the study of locomotion in the group of observed patients before and after rehabilitation activities are presented in Figure 4.

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Fig. 4 Dynamics in locomotion

The Bartel index (Me (Range)) shows a tendency to increase from 80 (0-95) to 95 (10-100) at the end of the course of treatment. There is a statistically significant improvement of the index - Z = 9.446; p <0.001. At the beginning of the rehabilitation patients with complete dependence (0-20 points) were 18%, with strong dependence (21-60 points) - 10%, with moderate dependence (61-90 points) - 69% and with mild dependence (91- 99 t.) - 3% of the tested group. After treatment, the results were as follows: 13% of patients were completely dependent, 13% strongly dependent, 10% were moderately dependent and 64% were mildly dependent.

4. DISCUSSION

The goal of the presented pilot study was to examine the impact of a rehabilitation program on motor recovery, daily functional activity, and quality of life in stroke patients. Male patients predominate in the group examined by us. The urban population with secondary and higher education predominates, which is probably related to the urban life and related daily activities and levels of stress. In the beginning of the rehabilitation, almost half of the patients had strong or moderately strong motor deficit and discoordination disorders, with those from first and second groups prevailing. After the rehabilitation, the share of patients with a mild degree of motor deficit - third group, increased. The assessment of the rehabilitation potential of the patients and the objective testing of the motor deficit and the stage of motor recovery according to Brunnstrom help to build an adequate rehabilitation program. According to publications, a number of concomitant diseases of the cardiovascular system, arterial hypertension, diabetes mellitus, etc. are found in some patients hospitalized with ischemic stroke, which can prolong the period of

hospitalization and be fatal (De Stefano, F., Mayo, T., Covarrubias, C., et al. (2021)). Applying adequate rehabilitation measures could prevent possible complications related to the concomitant comorbidity. Preliminary data from the AVERT study for immediate physical therapy in the first 24 hours suggest good tolerance and shows no increase in side effects (Olsson, BG, Sunnerhagen, KS, (2006); Ováry C, Szegedi N, May Z, Gubucz I, Nagy Z. (2007)).

Intensive rehabilitation, with emphasis on the time for exercising daily activities (DAE), is associated with improved functional outcome. The organization and quality of care may be more important than the absolute number of hours of therapy. Patients should also be examined for depression during and after hospitalization, by follow-up (De Wit L, Putman K, Dejaeger E, et al. (2005); De Wit L, Putman K, Schuback B, et al. (2007)).

Impaired motor activity, disturbances in terms of balance, locomotion, fine motor skills, self-care, performance of daily activities and independence of the patient, worsen his/her QoL and prove the need for rehabilitation. In patients with ischemic stroke, it is necessary to start immediately after mastering the acute symptoms, to be gradual and complex, corresponding to the recovery process, and the rehabilitation measures must be consistent with the degree of damage to the central nervous system, existing motor deficit and concomitant diseases. It is good to carry out rehabilitation when functional recovery is fastest, and it is advisable to continue at least until the 18th month after the accident in a form appropriate to the severity of the disease. It is recommended to conduct complex rehabilitation courses several times a year, and after the 6th year - annual courses supporting physiotherapy courses.

In our study, we found a significant improvement in the testing of patients' motor function and the Brunnstrom Functional Recovery stage. There is a reduction in the relative proportion of patients with spasticity and discoordination disorders. The share of non-verticalized patients was one third of all patients before rehabilitation, and after rehabilitation this percentage decreased significantly, while the number of patients with self-locomotion with or without an aid was increased.

Taking into consideration the global financial crisis affecting all Health Systems, rehabilitation interventions are preferred, not only because of their effectiveness, but also in order to reduce costs in the acute phase. Initially the rehabilitation starts with on-site rehabilitation in the Department of Acute Conditions and continues in the Physiotherapy Department, where the patients are transferred.

There is increased survival and improved functional outcome for patients treated there, as well as long-term benefits of specialized treatment. The significant financial and social consequences of long-term hospitalization increase the interest in structures that support early return of patients to society (Langhorne, P., & Duncan, P. (2001); Langhorne, P., Taylor, G., Murray, G., et al. (2005)). Specialized rehabilitation wards are needed, especially that mortality increases significantly when patients are discharged early and entrusted only to the care of their relatives (De Wit L, Putman K, Dejaeger E, et al. (2005); De Wit L, Putman K, Schuback B, et al. (2007)). Treatment in a specialized department for PRM significantly improves the prognosis for all types of strokes, regardless of age and sex of the patient, as well as the severity of clinical symptoms (Ilieva, E., Gonkova, M., Moslavac, S., Anastassova, E., Todorov I. (2015)).

The physiotherapeutic approach can reduce clinical and functional complications and increase the recovery and the quality of individual result, reduce the risk of deterioration in functioning and improve the QoL of these patients. (Kim T. (2021)). In modern epidemiological studies, in addition to determining the frequency and description of clinical manifestations, attention should be paid to changes in the physical, mental, and social condition of patients. Elkova, H. (2015)

5. CONCLUSION

The complex rehabilitation program applied by us in the study leads to reduction in motor deficit and discoordination syndrome, as well as improvement of the daily functional activity in the examined group of patients with stroke. In order to better objectify the obtained results, it is necessary to continue the study, with larger number of patients included.

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