

Physical Rehabilitation of Stroke Patients Using Force Plate within Frame of Government Healthcare Programme

Elena Vladislavovna Kaerova¹, Olga Viktorovna Shakirova^{2*}, Natalya Sergeevna Zhuravskaya², Nina Valentinovna Kozyavina² and Larisa Sergeevna Pavelkina²

¹Pacific State Medical University, Russia

²Far Eastern Federal University, Russia

***Corresponding Author:** Olga Viktorovna Shakirova, Far Eastern Federal University, Russia.

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Abstract

In disregard of the achievements in the medical practice, the problem of the relief of the sequelae of the apoplectic attack still remains unsolved. The disability after the insult compiles the high percentage. Thus, the search of new technologies for solving the problem of recovery of the gone body functions, improving the quality of life, restitution to the normal working activity are particularly important today. The rationale is confirmed by the aims and strategies of the state programme "Health Development" designed for realization as far as 2015. As follows from the analysis of the research and methodological base on the multidisciplinary problem of rehabilitation after the insult, the authors revealed the stages of this process: the patient's personal interest, the comprehensive diagnosis of the motor impairment on the force plate, substantiating the choice of the special means of rehabilitation. The complex programme of the patients' rehabilitation has been developed on the basis of the use of the special exercises on the force plate and balancing platforms in the early period of the ischaemic stroke. The positive dynamics of the motor function, life quality, psycho-emotional state of the patients is proved as a result of the appliance of the complex programme of rehabilitation on the basis of the use of the special exercises on the force plate and balancing platforms.

Keywords: Force Plate; Physical Rehabilitation; Stroke Patients; Government Programme "Health Development"

Introduction

The disability of the stroke patients is principally conditioned by the severity of the disordered motor functions. According to the research data, no more than 15.0% of the patients return to work after the insult, one third of them are people of the productive age [4]. The frequency of the insults in the able-bodied people in the age 25 - 65 years is 2.5 - 3 cases per 1,000 people among the urban population and 1.9 cases per 1,000 people among the rural population [6]. At the same time, the state programme "Health Development", proved by the Government of the Russian Federation on December 26, 2017, pays special attention to the problems of health of the able-bodied population [11]. While the rehabilitation of the stroke patients, the force plates are successfully used (2016), allowing, according to the principle of the biofeedback, to give the objective assessment to the pathology of the balance function, peripheral nervous system, pathology of the vestibular and visual analyzers, to estimate the functional status of the human nervous system [2,5,7]. The analysis of the available literature reveals that the data of the biofeedback received at the force plate, are not always used as a simulator of the motor impairment and control of the effectiveness of the complex physical rehabilitation of the stroke patients and today there is a need to get the argumentative base on the appliance of the force plate [1,9].

Methods

To describe the initial condition of the patients after the ischaemic stroke, the analysis of the medical documentation (outpatient cards, patient medical records) was used. Three groups were formed by random sampling according to the purpose of this research

work and in dependence from the programme of the physical rehabilitation. The group of the surveyed people included 28 people, 18 of whom composed two experimental groups (EG1, EG2) of nine persons in each and 10 persons composed the control group (CG). The EG1 included the people who received the therapeutic exercises with the appliance of the balancing platforms. At the same time, exercises of medical physical culture were selected individually, depending on the severity of paresis and functional disorders. The EG2 patients were also given the classes of the therapeutic exercises using the balancing platforms and additionally the training sessions on the force plate with the biofeedback. The CG included the patients engaged into the medical physical culture according to the programme specified for the neurological patients, providing the general tonic effect, aiding the recovery and improving the self-care skills, balance and movement functions. The structural component of the programme on the basis of the use of the balancing platforms of different kinds, based on the principle of stage-by-stage approach and used by us during the process of rehabilitation of the post-stroke patients are the different movements, assisting to the formation of balance and equilibration, dexterity training and movement coordination of the lower and upper limbs. The programme of the movement correction was compiled individually depending on the initial characteristics of the pathologic movement pattern of the patient. The rehabilitation course consisted of 14 training activities with a running time from 30 to 45 minutes. We used several tests to characterize the values of balance, mobility and self-care: Berg scale (Bergbalancescale - BBS), Tinneti scale, Timer Walking Test, Barthel index, stabilometrics. To characterize the values of life quality and degree of independence in daily activities we used the questionnaire MOS SF-36 (J.E. Ware, 1992) and its Russian version SF-36 (according to A.N. Belov's questionnaire) for studying all the components of life quality. This questionnaire allowed us to give the complex assessment of the physical, psychological, emotional and social functioning.

Results and Discussion

The study engaged 28 patients, 20 men (71.42%) and 8 women (28.58%). The age of the tested persons varied from 25 to 80 years. The most numerous occurred the age group from 51 to 60 years - 9 people (32.14%) and the age group from 61 to 70 years - 8 people (28.58%). 46.0% of them were in the active working age. Only men were the patients in the age group of 25 - 40 and 71 - 80 years. The risk factors as smoking and alcohol overuse were observed in 15 people (53.57%) and 9 people (32.0%) correspondingly. The arterial hypertension was revealed in 13 people (46.4%), atherosclerosis - in 17 people (60.7%), the combination of arterial hypertension and atherosclerosis was revealed in 12 people (42.85%), discirculatory encephalopathy was revealed in 11 patients (39.3%), ciliary arrhythmia - in 9 patients (32.0%), ischemic heart disease - in 14 people (50.0%), chronic cardiac insufficiency in 8 patients (28.6%) and diabetes mellitus in 4 patients (14.2%). The concomitant diseases (pneumonia, urinary tract infections, thrombophlebitis) were revealed in 11 patients (39.3%). 8 (28.6%) people suffered from obesity, the stressful situation during 6 months before the stroke was observed in 16 (57.1%) people, the low physical activity was in 20 people (71.4%). The movement disorders, balance disorders, postural balance disorders were observed before the start of the complex physical rehabilitation at the outcome analysis of the initial examination of the patients after the stroke according to different tests. All the patients had the troubles with self-care and mobility and required the outside help, all of them had the reduced indicators of quality of life. The developed complex programme of physical rehabilitation with the use of the instable balancing platforms and training at the force plate provided in a greater degree the increase of degree of independence, self-care and mobility in everyday activities, decrease the level of the personal and state anxiety, the improvement of the psychoemotional state of the patients in comparison with the traditional programme of the curative physical training, specified for the neurological trainings. The carried out research allowed to prove the positive changes: according to Berg Balance Scale in CG the indicators increased by 19.2% (from 35.5 to 42.3 points), in EG1 - by 26.2% (from 35.5 to 44.8 points) and in EG2 - by 29.6% (from 36.1 to 46.8 points). The increase of the level of the daily living activities referring to self-service, according to Barthel Index was observed: in CG by 15.8% (from 61.5 to 71.2 points), in EG1 by 18.6% (from 62.2 to 73.8 points) and in EG2 by 26.9% (from 62.1 to 78.8 points). There was a significant ($p < 0.05$) improvement of the balance and walking parameters, estimated according to the Tinneti scale, that reduced the risk of falling of the patients in EG2 by 41% (in CG by 24.0%, in EG by 27.0%). When the balancing platforms and trainings on the force plate are included into the programme of the physical rehabilitation, the significant ($p < 0.05$) improvement of the locomotor function indicator takes place compared with the initial values in the all groups according to the Time Walking Test of the speed indicators of walking and covered distance. The positive impact of

the programme of the physical rehabilitation with the use of the balancing platforms and training on the force plate upon the increasing of the independence degree was observed, and consequently the improvement of the quality of life, the more significant positive dynamics was observed in EG2, where the PF indicator achieved 61.1 points. The higher values according to the subscales VT (62.7 points) and MH (65.7 points), SF (61.1 points) out of maximum 100 were also registered in this group. The RP indicator, objectifying the degree of physical well-being influence upon the daily life, increased during the treatment process, at the same time remaining at rather low level (29.5 points). The less significant improvement was revealed according to the subscales, forming the psychological component of the quality of life. The significant ($p < 0.05$) decrease of the personal (by 30.35%) and state (by 25.6%) anxiety among the patients of EG2 was found, characterizing the increase of the activity and motivation of the patients to work and responsibility in solving their own health problems. The analysis of the indicators of the stabilometrical research allowed seeing the positive changes in the balance of the vertical is standing and walking. It was revealed that the area of pressure center and its vibrations, measured in the frontal and sagittal planes significantly change. The speed of the pressure center, the total amplitude in the frontal plane and the square (S , mm^2) of the statokinesiograms ($p < 0.05$) significantly decreased. The decrease of the average balancing parameters was registered according to the groups with the open eyes $S(o)$, mm^2 in EG2 by 54.66% (from 307.11 mm^2 to 239.23 mm^2), while in the CG - by 39.9% (from 427.1 mm^2 to 305.2 mm^2) and in EG1 by 23.7% (from 429.0 mm^2 to 346.8 mm^2). The change of the balancing parameters was revealed with the close eyes $S(c)$, mm^2 in EG2 by 28.68% (from 645.7 mm^2 to 505.5 mm^2), while in CG by 12.1% (650.6 mm^2 to 580.3 mm^2) and in EG1 by 22% (from 660.1 mm^2 to 540.9 mm^2). The significant reducing of the results of conveyance speed of pressure center was revealed in the patients with the open eyes $V(o)$ in EG2 by 27.1% (from 13.90 mm/s to 10.94 mm/s), while in CG it decreased by 18.93% (from 14.42 mm/s to 11.69 mm/s) and in EG1 by 21.03% (from 14.07 mm/s to 11.11 mm/s). The significant reducing of the results of conveyance speed of pressure center was revealed in the patients with the closed eyes $V(c)$ in EG2 by 40.12% (from 18.27 mm/s to 10.94 mm/s) while in CG it decreased by 4.5% (from 20.42 mm/s to 19.15 mm/s) and in EG1 by 12.85% (from 22.64 mm/s to 19.73 mm/s). The patients of EG2 most achieved to the statutory indicator $V(o) = 10.94 \text{ mm/s}$ at the norm < 10.6 and to the statutory indicator $V(c) = 11.15 \text{ mm/s}$ at the norm < 11.5 . In CG and EG1 these indicators differed from the standard ones. These changes objectively reflect the improvement of balance stability. Thus, the results of the final test of the support of the vertical posture and balance, mobility, restoration of the social-domestic independence and quality of life of the stroke patients allowed to prove the effectiveness of the therapeutic exercises complex with the appliance to the instable balancing platforms and trainings on the force plate.

Conclusion

The obtained results proved the high effectiveness of the complex physical rehabilitation with the appliance of the instable balancing platforms and trainings on the force plate aimed to increase the mobility, balance, improvement of the motor skills, improvement of the life quality of the stroke patients at the stationery stage in the early recovery period. That is enable to consider the developed methodology fulfills the tasks within the frame of the activity "Medical Care Rendered in Framework of Clinical Testing of Methods of Prophylaxis, Diagnostics, Treatment and Rehabilitation" and "Development of Medical Rehabilitation" included into the sub-programmes of the 2nd and 3rd state programmes "Healthcare Development".

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