Elaborate Ways for Rehabilitation Stroke Patients Using Drug Treatment with Cerebrolysin *vs.* Advanced Physical Therapy Techniques

MERCEDESZ GHEORGHIAS[1,2], DIANA ANDREI[3], DAN V. POENARU[4], GHEORGHE MIHAI BANARIU[5,6], OANA MICLAU[7], MARIA ALEXANDRA PREDA[1]*, LAVINIA STELEA[8], MADALINA PALFI[1]*, ALEXANDRU LUCHIAN[1,9], MIHNEA MUNTEANU[1]

[1] Victor Babes University of Medicine and Pharmacy, Department of Ophthalmology 2 Eftimie Murgu Sq., 300041, Timisoara, Romania

[2] Prof. Dr. Agrippa Ionescu Clinical Emergency Hospital, 149 I.C. Brătianu Street, 077015 Balotesti, Romania

[3] Victor Babes University of Medicine and Pharmacy, Department of Balneology, Medical Rehabilitation and Rheumatology, 2 Eftimie Murgu Sq., 300041,Timisoara, Romania

[4] Victor Babes University of Medicine and Pharmacy, Department of Orthopaedics and Traumatology, 2 Eftimie Murgu Sq., 300041, Timisoara, Romania

[5] Carol Davila University of Medicine and Pharmacy; 8 Eroii Sanitari Blvd., 050474, Bucharest, Romania

[6] University Emergency Clinical Hospital 169 Independenei Spl, 050098, Bucharest, Romania

[7] West University, Department of Physical Education and Sport, 4 Vasile Parvan Bd, 300223, Timisoara, Romania

[8]Victor Babes University of Medicine and Pharmacy, Department of Obstetrics and Gynecology, 2 Eftimie Murgu Sq., 300041, Timisoara, Romania

[9] Clinical Hospital of Orthopedics-Traumatology and TBC osteoarticular, Ferdinand Bvd I 35-37, 030167, Bucharest, Romania

Stroke patients are a major problem for their families because of the weight and limitations of recovery procedures. In this study, it is desired to show the benefits of virtual reality utilization both singularly and in tandem with the drug, namely the dual use of virtual realities and cerebrolysin. The aim of the study was to evaluate the overall functioning of patients diagnosed with stroke and their recovery.We compare patients who received drug treatment and physiotherapy and those who benefited from advanced physiotherapy (assisted by virtual reality) and drug treatment. The study group has a total of 42 participants (15 women and 27 men), of whom 22 received medical treatment and 20 underwent medical treatment and a virtual reality based physical therapy. The study also shows the starting point for rehabilitation respectively that how started rehabilitation prior to the 1-year mark and after the 1 year mark.The analysis was carried out over a period of 1.5 years in the hospital with a specially militarized status for the former patients and followers for a period of 1 years and seeing their evolution in several tests of: balance, posture, speed and assessment of the degree of functionality. The Health Improvement Analysis was done on these parameters and on the answers given in a clinical self-evaluation questionnaire. The physical therapy and exercise added to medical treatment play a considerable part in the recovery of overall functioning of patients with stroke.

Key words: Stroke, virtual reality, physio therapy, cerebrolysin, rehabilitation

Stroke patients are a major problem for their families because of the weight and limitations of recovery procedures. Besides the special attention that stroke patients must have at risk factors, it is very important to recover them and increase the quality of life at these patients [6, 7].

In this study, it is desired to show the benefits of virtual reality utilization both singularly and in tandem with the drug, namely the dual use of virtual realities and cerebrolysin.

Experimental part

The study group has a total of 42 participants (15 women and 27 men), of whom 22 received medical treatment respectably: medical rehabilitation (physical therapy and electrotherapy) accompanied by pharmacological treatment (cerebrolysin) and 20 underwent medical rehabilitation (physical therapy and electrotherapy) accompanied by pharmacological treatment (cerebrolysin) and a virtual reality based *physical therapy*. Cerebrolysin administration protocol: 10 consecutive doses of 10 mL i.v. diluted in saline solution 500mL.

Basically the two study lot's have received the same treatment respectably: electrotherapy: toning electrical stimulation for flaccid muscles and decontracturant electrical stimulation for spastic muscles, ultrasound therapy, laser therapy, cryotherapy, shortwave therapy, tecar therapy, shock wave, lymphatic drainage, relaxing massage, physical Therapy: The Kabat method, The Bobath method, The Brunnstrom method, The Jacobson method, Ocupational therapy, Hidro kinetotherapy and the only diference is given throw the application of virtual reality.

The study also shows the starting point for rehabilitation respectively that how started rehabilitation prior to the 1-year mark and after the 1 year mark.

Table 1 shows an overview of patient characteristics in each group. Statistical tests did not found statistically significant differences of age, gender, stroke etiology proportions, living areas, and body mass index.

An important result was the absence of statistically significant difference regarding the time elapsed from

* email: superstarale@yahoo.com, mada_palfi@yahoo.com

Table 1
DESCRIPTIVE STATISTICS OF STUDY GROUPS

	Group 1 (n=22)	Group 2 (n=20)
Age (mean ± SD)	62.1±12.1	57.6±10.9
	p=0.226	
Female (n)	9	6
Male (n)	13	14
	p=0.461	
BMI (mean ± SD)	27.3±4.43	28.3±3.62
	p=0.445	
Ischemic (n)	16	12
Hemorrhagic (n)	6	8
	p=0.382	
Living in an urban area (n)	10	14
Living in a rural area (n)	12	6
	p=0.108	
Time elapsed from stroke (years) (mean ± SD)	6±4	4.95±2.98
	p=0.415	

n – number of observations
SD – standard deviation
p – p value of the statistic test
BMI – body mass index

stroke. In order to draft the protocol, the following tests are considered:

10-meter walk test (normal speed)

The test protocol is as follows: Measurement of the depression velocity (m / s) analysis is done at a distance of 10 meters of which 2 meters represent the acceleration phase, the following meters represent the actual travel speed and the last 2 meters represents the deceleration phase. The actual measurement will be made after exceeding the 2-meter line and will cease to reach the 8-meter distance and the result as a 6-meter pronounced time enters the mark of 2 and 8 meters respectively will be divided to 6 for the speed playback in meters second according with the existing studies [1].

The test is performed on admission and discharge and the results are compared. Please note that to prevent possible errors, the test is performed 3 times with pauses between repatriations and only when the patient declares that it is at the level of response and the speed in m / s is given as an average displacement value for the 3 sample tests.

The number of steps 10-meter distance

As the name suggests, the test refers to the number of steps the patient makes for a distance of 10 meters [2]. This measurement is done by showing the number of steps (entire) even if the patient succeeded with the last step to exceed the mark of 10 meters.

10-meter walk test (swift speed)

The test protocol is as follows: Measurement of the depression velocity (m / s) analysis is done at a distance of 10 meters of which 2 meters represent the acceleration phase, the following meters represent the actual travel speed and the last 2 meters represents the deceleration phase [3]. The actual measurement will be made after exceeding the 2-meter line and will cease to reach the 8-meter distance and the result as a 6-meter pronounced time enters the mark of 2 and 8 meters respectively will be divided to 6 for the speed playback in meters second.

The test is performed on admission and discharge and the results are compared. Please note that to prevent possible errors, the test is performed 3 times with pauses between repatriations and only when the patient declares that it is at the level of response and the speed in m / s is given as an average displacement value for the 3 sample tests.

2 minute walk test

This test measures the distance and the number of steps passed by the wearer and whether it has moved by itself or by means of a locomotive or baton or crutches [4]. The test is performed on admission and discharge and the results are compared [5].

SF-36 Health Questionnaire

The quality of life analysis was done using the standardized questionnaire: SF-36 Health Questionnaire.

The life quality assessment scale was based on the standardized questionnaire used in the medical units. It is a scale that evaluates 6 areas of everyday life.

Experimental part

Material and method

Hospital corridor with a length of 100m and markings indicating the distance traveled.

Standardized physical therapy apparatus and treatments according to the respective unit norms (Military Hospital).

Advanced physical therapy techniques (using virtual reality-VirtualRehab). VirtualRehab is a clinically validated and CE certified complement to physiological recovery therapies for the patient with varying degrees of physical disability. It uses motion capture technology from Microsoft® Kinect sensors to turn the patient into a protagonist of video games interacting with 2D and 3D gaming environments. A multidisciplinary group of opinion leaders from neurology and physiotherapy has collaborated to develop VirtualRehab. It has been clinically validated on the basis of studies conducted in 2012. Their results have proven the utility of VirtualRehab in recovering patients combined with traditional therapies and were presented at the 8th World Conference on Neurorecuperation in 2014 in Istanbul. Virtual Rehab has been created to improve the quality of life of patients with neurodegenerative, neuromuscular and neurovascular pathologies and to improve the mobility of the elderly. One of the main benefits of Virtual Rehab systems is that it provides a new and exciting platform for making a number of repeated recovery moves to encourage neuroplasticity. Virtual Rehab offers the only way to include Constraint-Induced Movement Therapy (CIMT) - Induced Constraint Motion Therapy. VirtualRehab is a flexible tool that allows specialists to create complex treatment programs. Combining various therapeutic exercises with the appearance of games, ensures an efficient and engaging recovery process; increases patient satisfaction, leading to greater involvement and visible progress. VirtualRehab Body consists of a set of exercises designed to recover upper and lower limb motor functions for a wide range of neurological pathologies. Through interactive games, the system allows the return of abilities such as balance, body weight transfer, target achievement, muscle tonicity, effort resistance. These are major issues in the daily life of the patient for daily activities: feeding, hygiene, dressing, etc.

One of the first attempts to use virtual reality in the treatment alongside physical therapy was a non-

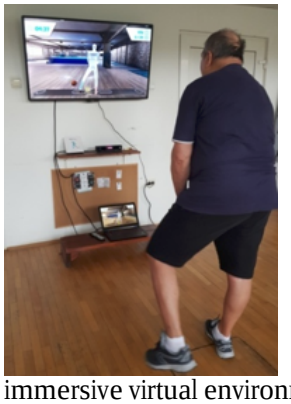

Fig.1 Physical exercise with virtual reality

immersive virtual environment for training gentle physical movements for stroke patients.

These exercises proved to be a good stimulus both in terms of physical exercise and the morale of many patients who were funny (the statements of the patients who found amusement and hope through these exercises and stated that they gave them a state of calm and reduced anxiety)(fig.1).

The measurement form analyzes data about convenient (normal) and fast (step-by-step) walking on a

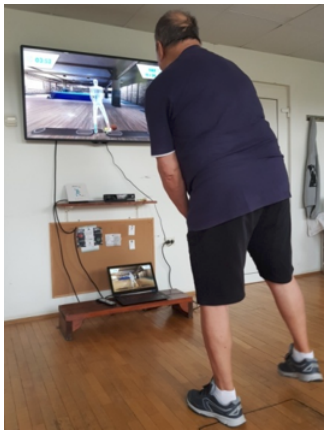

Fig.2 Step-by step exercise

predetermined route as well as the travel speed and the number of steps required for this route (fig.2).

The Microsoft Kinect SDK recognizes 20 joint points of the human body: HipCenter, Spine, ShoulderCenter, Head, ShoulderLeft, ElbowLeft, WristLeft, HandLeft, ShoulderRight, ElbowRight, WristRight, HandRight, HipLeft, KneeLeft, nkleLeft, FootLeft, HipRight, KneeRight, AnkleRight and FootRight [8].

The 2-minute walk test gathers and analyzes the following data:

If walking was done with or with a device or without outside intervention, the distance covered within 2 min and the number of steps made by the patient on that route and whether it was improved as a distance and as a reduction in the number of steps. Tests of continuous variables were carried out after the test of normality.

Unpaired and paired T-tests, as well as Wilcoxon rank-sum und signed-rank tests were performed for continuous variables.

Wilcoxon rank-sum test was used for questionnaires, whereas Chi-square test was conducted to test the categorical variables.

The statistical level of significance was set at 0.05, the aforementioned statistical tests being performed with R [X].

Results and discussions

All tests from table 2 did not show a statistically significant difference between groups at admission.

Table 2

TEST RESULTS AT ADMISSION

	Group 1 (mean ±SD)	Group 2 (mean ±SD)
Normal speed, 10-meter walk test	2.53±1.4	2.34±1.27
	p=0.696	
Swift speed, 10-meter walk test	1.87±1.23	1.66±1.08
	p=0.579	
Number of steps, 10-meter walk test	12.2±4.58	11.1±3.17
	p=0.374	
Center of gravity	13.3±4.46	12.2±3.62
	p=0.46	
Step length	13.1±5.89	16.2±8.06
	p=0.106	
Step dynamics	17±8.27	19.1±9.35
	p=0.493	
Distance, 2 minute walk test	69±31.79	70.3±18.2
	p=0.878	
Number of steps, 2 minute walk test	71.5±17.7	71.6±17.6
	p=0.979	

Table 3

QUESTIONNAIRE RESULTS AT ADMISSION

	Group 1 (median)	Group 2 (median)
SF-36 Health Questionnaire	88.5	88.5
	p=0.791	
Quality of Life Assessment	32	30.5
	p=0.869	

Table 4

PATIENTS IMPROVEMENTS

	Admission (mean ±SD)	Discharge (mean ±SD)
Normal speed, 10-meter walk test		
Group 1	2.53±1.4	2.47±1.41
	p<0.001	
Group 2	2.34±1.27	2.02±1.01
	p<0.001	
Swift speed, 10-meter walk test		
Group 1	1.87±1.23	1.78±1.2
	p=0.003	
Group 2	1.66±1.08	1.72±1.43
	p=0.002	
Number of steps, 10-meter walk test		
Group 1	12.2±4.58	11.4±4.76
	p=0.028	
Group 2	11.1±3.17	9.83±2.77
	p<0.001	
Center of gravity		
Group 1	13.3±4.46	13±4.25
	p=0.655	
Group 2	12.2±3.62	12.1±3.55
	p=0.055	
Step length		
Group 1	13.1±5.89	13.6±6.02
	p=0.109	
Group 2	16.2±8.06	18.7±7.33
	p<0.001	
Step dynamics		
Group 1	17±8.27	15.9±7.47
	p=0.109	
Group 2	19.1±9.35	18.1±8.9
	p<0.001	
Distance, 2 minute walk test		
Group 1	69±31.79	69.6±32.8
	p=0.291	
Group 2	70.3±18.2	131.9 ±204.6
	p<0.001	
Number of steps, 2 minute walk test		
Group 1	71.5±17.7	71.9±17.6
	p=0.488	
Group 2	71.6±17.6	85.7±16.6
	p<0.001	

Table 5
TEST RESULTS AT DISCHARGE

	Group 1 (mean ±SD)	Group 2 (mean ±SD)
Normal speed, 10-meter walk test	2.47±1.41	2.02±1.01
	p=0.371	
Swift speed, 10-meter walk test	1.78±1.2	1.72±1.43
	p=0.597	
Number of steps, 10-meter walk test	11.4±4.76	9.83±2.77
	p=0.376	
Center of gravity	13±4.25	12.1±3.55
	p=0.492	
Step length	13.6±6.02	18.7±7.33
	p=0.011	
Step dynamics	15.9±7.47	18.1±8.9
	p=0.714	
Distance, 2 minute walk test	69.6±32.8	131.9 ±204.6
	p=0.022	
Number of steps, 2 minute walk test	71.9±17.6	85.7±16.6
	p=0.013	

It can be seen from the table 3 that questionnaire results of patients from group 1 were not significant different from the results of patients from group 2.

Statistical tests from table 4 pointed out more improvements in group 2 than in group 1. The absence of significant differences at admission allowed a comparison of groups at discharge.

The results confirm the utility and usability of the digital patient in clinical reasoning and in educational applications as also confirmed by other studies [9, 10].

As for exposure riscks Microsoft Kinect is a marker less body scanning sensor based on an infra-red structured light architecture the harmful exposure of the screened patients is reduced to zero [11]. Apart from its utility to analyze clinical and electrophysiological parameters [12, 13].

Although tests from table 4 showed few improvements also in group 1, results from table 5 emphasized better outcomes of patients from group 2 regarding Step length and two-minute walk test.

Therefore, results from tables 4 and 5 revealed an improvement in the dual-treatment group with virtual reality and drug treatment over those who only benefited from drug treatment.

Also, the group that benefited from a virtual rehabilitation treatment onset before the one-year point experienced a greater improvement over those who benefited from dual treatment after one year.

Thus a complex medical rehabilitation therapy that is sustained and established early, can help improve an individualized recovery program (virtual recovery treatment).

Conclusions

The results revealed a significant improvement in the dual-treatment group over those who only benefited from drug treatment.

The group that benefited from a virtual rehabilitation treatment onset before the one-year point experienced a greater improvement over those who benefited after one year.

Thus complex medical rehabilitation therapy sustained and established early, can help improve an individualized recovery program (virtual recovery treatment).

References

1.VELDEMA J., BOESL K., KUGLER P., Ponfick M., GDYNIA HJ., NOWAK DA., Acta neurologica scandinavica, 140, no.1, 2019, p.62.

2.KLOTZ SGR., KETELS G.,et al., Physioscience, 15, no.2, 2019, p.73.

3.ALTUBASI IM., et al., Journal of musculoskeletal and neuronal interaction, 19, no.2, p.215.

4.URSIN MH., et al., Physiotherapy, 105, no. 2, p.254.

5.HANDELZALTS S., et al., Neurorehabilitation and neural repair, 33, no.3, p.213.

6.BALINT, GS., ANDONI, M., POPOVICI, RA., RUSU, LC., Rev. Chim. (Bucharest), **68,** no.10, 2017, p.2237.

7.BALINT, GS., IOVANESCU, G., STANCA, H., POPOIU, CM., BOIA, E., POPOVICI, RA., et al., Rev. Chim. (Bucharest), **68**, no.5, 2017, p.949.

8.GAL N., ANDREI D., NEMES DI., NADASAN E., STOICU-TIVADAR V., Europeans Studies in Health Technology and Informatics, Volume 210, p. 489, DOI 10.3233/978-1-61499-512-8-489.

9.GAL N., ANDREI D., POENARU DV., STOICU-TIVADAR V., GAL-NADASAN E., Studies in Health Technology and Informatics, Volume 228, p 147, DOI**:** 10.3233/978-1-61499-678-1-147.

10.GAL-NADASAN N., STOICU-TIVADAR V., POENARU DV., POPA-ANDREI D., GAL-NADASAN E., Advances in Intelligent Systems and Computing**,** Volume 633, p. 298, DOI 10.1007/978-3-319-62521-8_24.

11.MILICIN C., SIRBU E., Neurorehabilitation, volume 42, issue 1, p. 113, DOI 10.3233/NRE-172220.

12.LUCACI, P., NECULAES, M., HABA, D., Rev. Chim. (Bucharest), **70**, no. 5, p.1592.

13.GROSU, C., MASTALERU, A., NITA, O., COBZARU, R.G., RAPA, C.V., LEON-CONSTANTIN, M.M., COJOCARU, E., Rev. Chim. (Bucharest), **69**, no.12, 2018, p.3698.

Manuscript received: 22.11.2018