Effects of physical activity on functional and cardio respiratory capacity in multiple sclerosis

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Abstract

Multiple sclerosis (MS) is an inflammatory, demyelinising disease of the central nervous system which accounts for functional impairment and lasting disability in young adults. It occurs as a result of some combination of genetic susceptibility, deregulation of the immune system and environmental factors such as infectious and possibly other factors like vascular problems. The *objective* of this paper is to demonstrate if an intensive short-term inpatient rehabilitation program is able to improve clinical and functional outcome in multiple sclerosis patients. *Methods:* 15 patients with multiple sclerosis (mean age 37.06±9.66 years) were assigned to Expanded Disability Status Scale (EDSS) score. All patients were included in an intensive short-term rehabilitation program (strength and cardio respiratory exercises). Subjects attended 60-min sessions three times a week for 12 weeks. Ruffier-Dickson and Hettinger tests were performed. The patients were assessed before and after this physical intervention. *Results*: From the total 25 patients 50% were with remitting multiple sclerosis, 30% with secondary progressive multiple sclerosis and 20% with primary progressive multiple sclerosis. The EDSS score was improved in 70% of studied cases. All subjects recorded a better cardio respiratory performance evaluated by Ruffier-Dickson test. Hettinger assessment recorded after 12 weeks an improvement of 80% in the functional state. *Conclusions:* Strength (or resistance) training and cardio respiratory (or endurance) training are two basic physical exercises widely used in neurological rehabilitation. Application of an intensive rehabilitation program determines increasing of functional and cardio respiratory capacity in patients with multiple sclerosis.

Key words: *multiple sclerosis, rehabilitation, cardio-respiratory performance, functional state.*

Rezumat

Scleroza multiplă (SM) este o afecţiune inflamatorie, demielinizantă a sistemului nervos central care determină deficit funcţional şi handicapuri majore la adulţii tineri. Această boală apare ca urmare a factorilor genetici, dereglărilor sistemului imun sau poate fi indusă de factori de mediu precum infecţiile dar şi de factori vasculari. Scopul acestei lucrări este de a demonstra că aplicarea unui program intensiv pe termen scurt de activitate fizică determină îmbunătăţirea stării clinico-funcţionale la pacienţii cu scleroză multiplă. *Metode:* 15 pacienţi cu SM (vârsta medie 37,06 ± 9,66 ani) au fost evaluaţi cu ajutorul scalei extinse a stării de invaliditate EDSS (Expanded Disability Status Scale). Toţi pacienţii au fost supuşi unui program intensiv de activitate fizică (exerciţii de rezistenţă şi cardio-respiratorii). Durata programului a fost de 12 saptămâni,

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şedinţele fiind de 60 min, de 3 ori pe săptămână. S-au efectuat testele Ruffier-Dickson şi Hettinger. Pacienţii au fost evaluaţi înainte şi după aplicarea programului de antrenament fizic. *Rezultate:* Din cei 15 pacienţi incluşi în studiu, 50% au prezentat o formă de SM recurent-remisiva, 30% SM secundar-progresivă iar 20% SM primar- progresivă. Scorul EDSS s-a îmbunătăţit la 70% din pacienţii incluşi în studiu. În urma evaluării cu testul Ruffier-Dickson, toţi subiecţii au înregistrat o mai bună performanţă cardio-respiratorie. Metoda Hettinger a înregistrat, după 12 săptămâni, o imbunătăţire de 80% a statusului funcţional. *Concluzii:* Antrenamentul de forţă (sau rezistenţă) şi cel cardio-respirator sunt cele mai utilizate mijloace fizice utilizate în recuperarea neurologică. Aplicarea unui program intensiv de recuperare determină creşterea performanţei funcţionale şi cardio-respiratorii la pacienţii cu SM.

Cuvinte cheie: *scleroză multiplă, recuperare, performanţă cardio-respiratorie, status funcţional.*

Introduction

Multiple sclerosis (MS) is an immune-mediated inflammatory disease that attacks myelinated axons in the central nervous system (CNS), causing functional impairment and disability in young adults. The cause of this disease is not known, but it occurs as a result of some combination of genetic susceptibility, deregulation of the immune system and environmental factors such as infectious and possibly other factors like vascular problems [1].

Multiple sclerosis (MS) is characterized by fatigue, motor weakness, spasticity, poor balance, heat sensitivity and mental depression [1].

For many years, patients with multiple sclerosis (MS) have been advised to avoid exercise. However, several clinical trials have demonstrated that physical activity improves functional capacity in patients with multiple sclerosis. The physical exercises were designed to increase cardio respiratory fitness, muscle strength and mobility and to improve the quality of life [2, 3].

The objective of this paper is to demonstrate if an intensive short-term inpatient rehabilitation program is able to improve clinical and functional outcome in multiple sclerosis patients.

Material and method

The activity was conducted in the Timisoara County Hospital. A group of 15 patients with multiple sclerosis aged between 22 and 53, with an average age of 37.06±9.66 years was observed. We have worked only with the patients situated on stages 1-4 on the Kurtzke Scale.

All the 15 patients are in different stages of the illness, of different ages and with different symptoms and from different backgrounds and have undergone a recuperation treatment of kinetotherapy, cryotheraphy plus treatment with medication. The kinetotheraphy sessions were held three times a week.

The patients' repartition according to gender was as follows:

9 female patients – 60%

6 male patients – 40%

The patients' repartition on age groups was as follows:

20 – 30 years old – a total of 4 patients, 3 female and 1 male

31 – 40 years old – a total of 6 patients, 2 female and 4 male

41 – 50 years old – a total of 4 patients, 3 female and 1 male

Over 50 years old – 1 female patient.

Table I. Presentation of the patients in the studied group

Patient	Sex	Age	Profession	Type of SM	Illness Stage
1.	F	22	Student	Benign form	1.0
2.	B	24	Commercial agent	Benign form	1.5
3.	F	27	Taster	Relapsed, remitting form	2.0
4.	F	30	Civil servant	Secondary progressive form	4.0
5.	B	32	Pharmacologist	Relapsed, remitting form	2.5
6.	F	32	Doctor	Secondary progressive form	3.5
7.	B	34	Professor/Teacher	Relapsed, remitting form	3.0
8.	F	35	Photographer	Benign form	1.0
9.	B	38	Member of Parliament	Primary progressive form	3.5
10.	B	40	Judge	Primary progressive form	3.0
11.	F	44	Housewife	Relapsed, remitting form	2.5
12.	F	47	Pastry chef	Benign form	1.5
13.	B	49	Customs officer	Secondary progressive form	4.5
14.	F	49	Bank manager	Secondary progressive form	5.0
15.	F	53	Retiree	Primary progressive form	5.5

The patients repartition' according to the stage of the disease on the Kurtzke scale

stage 1 - 4 patients

stage 2 - 3 patients

stage 3 - 4 patients

stage 4 - 2 patients

stage 5 - 2 patients.

The expression of the score on the Kurtzke scale of the patient with multiple sclerosis is made in a dynamical relation by using the obtained values in the functional evaluations, which were generated initially and finally, but also in intermediary moments while performing the complete recuperation program.

The subjects were tested three times: initially, intermediary and finally, regarding the joint balance and the level of the voluntary motive capacity. Following this, two evaluations resulted:

- evaluation of joint mobility and balance (the Hettinger method)
- evaluation of muscular force;
- testing of the effort capacity (the Ruffier probe).

The Hettinger method represents a global evaluation system of the organism, which contains tests that appreciates the general mobility, the balance and muscular force [4].

The Ruffier probe consists of a simple test which can be applied to evaluate physical condition. It has as a basis the monitoring of the heart rate (HR) in the realisation of a standard effort – squats [4].

According to the results obtained, differentiated programs of kinetotheraphy were applied from the point of view of their complexity or modification of dosage. The patients evaluation was made initially, than again 1 month after starting kinetotheraphy (I_1), 2 months (I_2) and finally 3 months from the beginning of the study.

In the case of the patients evaluation through the Hettinger method, the obtained value in the test t Student was p=0.000272 which indicates extremely significant values – ES from a statistical point of view ($p<0.001$) (table II).

As regards the evaluation of the patients' illness stage on the Kurtzke scale, the obtained values in the test t Student was p = 0.012532, which indicates significant differences – S from a statistical point of view ($p<0.05$) (table III).

Table II. Presentation of the evaluations conducted on the patients of the group studied through the Hettinger method

Patient	Age (years)	Hettinger method			
		Initial	I_1	I_2	Final
1	22	67	67	74	76
2	24	64	62	68	71
3	27	60	30	64	65
4	30	31	61	34	37
5	32	57	40	64	66
6	32	43	48	44	44
7	34	46	67	51	55
8	35	65	44	70	73
9	38	40	43	47	40
10	40	39	58	45	46
11	44	53	60	61	61
12	47	58	32	61	68
13	49	29	23	29	26
14	49	21	20	23	24
15	53	18	20	21	17
Arithmetic average	37.06	46.06	45	50.4	51.26
Standard deviation	9.66	16.15	17.05	17.46	19.33
test t Student					0.000272

Table III. Presentation of the evaluations made on the patients within the studied group as regards the stage of the illness on the Kurtzke scale

Patient	Stage of the illness (Kurtzke)			
	Initial	I_1	I_2	Final
1	1	1	0.5	0.5
2	1.5	1.5	1.5	1
3	2	2	2	1,5
4	4	4	3.5	3
5	2.5	2.5	2	1,5
6	3.5	3.5	3.5	3,5
7	3	3	2.5	2
8	1	1	0.5	0,5
9	3.5	3.5	3.5	4
10	3	3	2.5	2.5
11	2.5	2	2	2
12	1.5	1.5	0.5	0,5
13	4.5	4.5	5	5
14	5	5	4.5	4.5
15	5.5	5.5	5.5	6
Arithmetic average	2.93	2.9	2.63	2.53
Standard deviation	1.41	1.43	1.59	1.74
test t Student				0.012532

In the case of the evaluation of the Ruffier index, the value obtained in the test t Student is p=0.000195 which indicates extremely significant values – ES from a statistical point of view statistic ($p < 0.001$) (table IV).

In the case of the evaluation of the patients as regards the score of the disabilities using the Kurtzke scale, the obtained value at the test t Student is p=0.001388, which indicates very significant differences – FS from a statistical point of view ($p < 0.01$) (table V).

Table IV. Presentation of the evaluation of the Ruffier Index

Patient	Ruffier Index			
	Initial	I_1	I_2	Final
1	0.02	0.01	0.01	0.01
2	2	0.02	0.01	0.01
3	7	5	3	2
4	17	13	10	5
5	5	3	1	0.05
6	13	11	9	7
7	11	9	6	4
8	0.05	0.03	0.02	0.02
9	11	9	5	10
10	11	8	6	4
11	7	5	4	3
12	3	2	1	0.05
13	16	14	12	12
14	17	16	14	14
15	17	17	16	15
Arithmetic average	9.13	7.47	5.80	5.076
Standard deviation	6.20	5.87	5.31	5.32
test t Student				0.000195

Table V. Presentation of the evaluations made on the patients from the studied group as regards the score of disabilities on the Kurtzke scale

Patient	Initial evaluation	Intermediary evaluation 1	Intermediary evaluation 2	Final evaluation
1	3	2	1	1
2	4	3	3	2
3	5	4	3	3
4	17	15	13	11
5	10	8	6	6
6	14	15	13	13
7	15	14	12	11
8	4	4	3	2
9	16	15	13	16
10	13	12	11	11
11	11	9	9	8
12	6	5	3	1
13	18	18	19	19
14	20	19	18	17
15	22	23	23	24
Arithmetic average	11.86	11.06	10	9.66
Standard deviation	6.29	6.58	6.76	7.22
Test t Student				0.001388

Discussions

Mobility disorders are very often the first visible in SM patients. That is why the restoration and re-education of the posture and mobility disorders caused by SM constitute the major activity of the therapist. Moreover, kinetotheraphy must reduce spasticity, must prevent muscle atrophy and must improve muscular fitness and the effort capacity [5]. The treatment of spasticity is essential. because it prevents active movement. The reduction of a high muscle tonus is done to a level in which residual voluntary movement can be used for a better mobility. Through the stretching of the affected

muscles and the maintaining of the stretch over a very long amount of time, the spasticity can be reduced and the efficiency of voluntary movements increased [6].

In our study all patients were included in an intensive short-term rehabilitation program (strength and cardiorespiratory exercises). Subjects attended 60-min sessions three times a week for 12 weeks. From the total twenty-five patients 50% were with remitting multiple sclerosis, 30% with secondary progressive multiple sclerosis and 20% with primary progressive multiple sclerosis.

Following a therapeutic intervention, a significant improvement of a functional disability was recorded and evaluated with the Kurtzke scale ($p < 0.01$). The EDSS score was improved in 70% of our cases.

All subjects registered a better cardiorespiratory performance evaluated by the Ruffier-Dickson test.

Furthermore, the patients have registered significant improvements of muscular force, joint mobility and balance ($p < 0.001$).

Our results coincide with those from the specialized literature. Several studies have shown the benefits of physical training, with improvements in aerobic capacity, gait parameters, fatigue and an influence on quality of life [5-7].

Petajan JH et al. have shown that physical activity can be classified in a pyramid structure, with the most basic functions forming the base and the most integrated functions on top. This pyramid progresses through passive range of motion, active resistive, specific strengthening and integrated strength exercises [7].

One can thus say that kinetotheraphy is the only way of improving the patients physical capacities and the main form of therapy that can offer functional independence during daily life.

Conclusions

In the case of all patients, improvement of muscular force, joint mobility, balance, pace and ADLs has been noticed.

Following the study, we have noticed the following: moderate increase of muscular force in the case of 10 patients; improvement of coordination in the case of all the patients; the increase of the maximum walking distance: the maximum distance that patients can reach by walking has risen with 300 meters for those in stages 1-2, who upon initial evaluation could walk approximately 800-1000 meters without help or accentuated fatigue; spasticity reduction in the case of 5 patients: following the application of exercises, spasticity decreases in the majority of cases, consequently registering an improvement of joint mobility.

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