Influences of Rehabilitation Treatment on Reduction of Spasticity for Stroke Patients

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ABSTRACT
This study was conducted to investigate the effects of a treatment method that can apply the theory of neuroplasticity used in rehabilitation treatment of stroke patients on spasticity. In this study, 26 people diagnosed by a rehabilitation medicine specialist were divided into experimental group and control group using a random assignment method. Experimental group received extracorporeal shock wave therapy after proprioceptive neuromuscular facilitation treatment, and control group received proprioceptive neuromuscular facilitation treatment. All treatments were performed 5 times a week for 4 weeks, and pre- and post-evaluation were conducted. Spasticity was measured to evaluate the treatment effect. In the results of the study, the decrease in spasticity was statistically significantly higher in experimental group than in control group. In conclusion, in order to improve the quality of life of stroke patients and return to society quickly, various treatment methods should be applied simultaneously.

Keywords: Rehabilitation, Spasticity, ESWT, Neuroplasticity
DOI Number: 10.48047/nq.2022.20.19.NQ99213 **NeuroQuantology2022;20(19): 2522-2528**

INTRODUCTION

Stroke is a case of cerebrovascular disease caused by blood circulation disorder, which means that symptoms of local or global neurological deficit persist. Stroke is a major cause of disability in adults. Disorders such as muscle weakness, loss of range of motion, and imbalance result in motor control disorders that affect the ability of stroke survivors to live independently and be economically self-sufficient [1]. Many traditional therapeutic interventions have been used in rehabilitation to promote functional recovery, but research findings are inconsistent, and recent evidence suggests that intensive, repeated treatments are required to modify neural tissue and restore motor function [2].

The reason why rehabilitation treatment applied to stroke patients should be started as soon as possible is to prevent deterioration of disease progression due to deterioration of dependence, increase the patient's independence, and improve the

quality of paralysis-side movements to the degree of brain damage. In other words, the initial treatment is the goal of treatment to harmonize both sides as much as possible [3].

Improving walking ability for social activity and functional recovery after stroke is the biggest challenge in rehabilitation of patients and one of the important treatment goals. Therapeutic approaches to improve walking ability include muscle strengthening of the lower limbs, task-oriented exercise, exercise image training, extracorporeal shock wave therapy, and treadmill gait training [4,5].

Various physical stimuli have been shown to stimulate healing responses through cell biochemical signal transduction and ultimately promote tissue repair, and may serve as important adjuvants in the healing of complex injuries. In clinical medicine for the last 40 years, extracorporeal shock wave therapy has been used for several indications, and recent data support its use in complex soft tissue wounds and ischemic tissues [6]. Although the exact mechanism of extracorporeal shock wave therapy in ischemic soft tissue is slowly beginning to be elucidated, it supports the hypothesis that the application of physical energy in the form of shock waves or mechanical stimulation influences the cellular response of damaged tissue and promotes recovery with beneficial biological effects [7].

In addition, a direct effect of mechanical stimulation of extracorporeal shock wave therapy on muscle fibers adjacent to tendons cannot be ruled out, and long-lasting intermittent tendon pressure can reduce spinal excitation clinically or neurophysiologically [8]. Shock waves are a series of single acoustic therapy methods characterized by high peak pressure, rapid pressure rise and short duration. Preliminary data showing that muscle tension decreased in nervous system patients after shock wave therapy and the continuous clinical effect of shock wave therapy on EMG can be used as evidence for the use of shock wave therapy in patients experiencing muscle hypertonia [9]. In this study, extracorporeal shock wave therapy, which can promote neuroplasticity, was applied to the paralyzed lower extremity to investigate its effect on reducing spasticity, which are essential for increasing independence in stroke patients.

RESEARCH METHOD

Subjects

In this study, 26 patients receiving rehabilitation treatment at a hospital after being diagnosed with a stroke at a rehabilitation hospital were selected as study subjects. In this study, patients who had been diagnosed with a hemiplegic stroke for more than 12 months as a result of a brain imaging-based specialist diagnosis were selected as study subjects.

This study was conducted by dividing into experimental group and control group using the random assignment method. Experimental group (n=13) received extracorporeal shock wave therapy on the affected lower extremity after

proprioceptive sensory neuromuscular facilitation treatment, control group (n=13) received proprioceptive sensory neuromuscular facilitation. Therapeutic intervention of each group was conducted 5 times a week for 4 weeks, a total of 20 sessions.

Methods

To apply extracorporeal shock wave therapy to experimental group A, an extracorporeal shock wave therapy machine that generates shock waves was used. In order to apply extracorporeal shock wave therapy to the patient, the patient was placed in a side-lying position with the hemiplegic lower extremity uplighted, and then shock wave stimulation was applied to the patient at 3 Hz and power was applied in one step [10].

In this study, the Modified Ashworth Scale was used to evaluate the lower extremity spasticity of patients [11]. The MAS is a test that uses the resistance to passive movement of various joints, score ranges from 0 to 4, with a score of 1 meaning no resistance and a score of 4 meaning very high resistance. In order to evaluate MAS, the environment was created so that the patient was not affected by the surroundings as much as possible, and the therapist measured the passive movements of the lower extremities to be measured after properly aligning the body.

Data analysis

Data collected to evaluate spasticity, ankle angle, and gait ability were analyzed using SPSS 18.0 for Windows. Normality was verified using the shapiro-wilk test, and was described as mean ± standard deviation using descriptive statistics. A paired t test was conducted to find out the difference between the pre-test and post-test within experimental groups and control group, and an independent t test was conducted to find out the difference in the amount of change between groups. And the significance level was set at $\alpha<0.05$.

RESULTS

In the MAS conducted to find out the spasticity of the subjects, experimental group showed a statistically significant decrease in spasticity, from an average of 2.48 points before the experiment to 1.27 points after the experiment($P<0.05$). However, in control group, the average spasticity level decreased, but there was no statistically significant change($P>0.05$)(Table 1).

Table 1. Comparison of modified Ashworth scale each group

	Pre-test	Post-test	t	P
Experimental group	2.48±0.26	1.27±0.31	-1.035	0.000*
Control group	2.31±0.34	2.02±0.29	-0.264	0.162

t	0.648		
P	0.031**		

Experimental group: Extracorporeal shock wave therapy after PNF
Control group: PNF
*: Paired t-test P<0.05, **: Independent t-test P<0.05, Unit: Score
In a comparison between groups to compare the effects of treatment, experimental group to which extracorporeal shock wave therapy was applied showed a statistically significant reduction in spasticity compared to control group to which PNF was applied(*P*<0.05)(Figure 1).

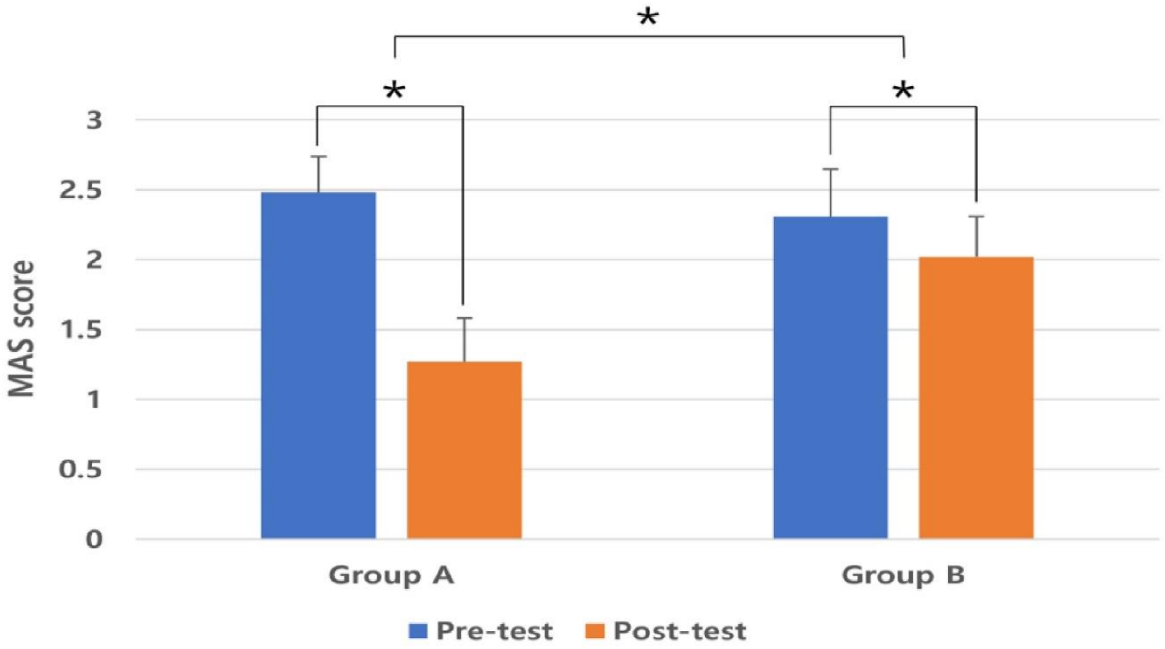

Figure 1. Comparison of modified Ashworth scale between groups
Group A: Extracorporeal shock wave therapy after PNF, Group B: PNF, *P<0.05

DISCUSSION

Stroke patients do not have the ability to control the nervous system and activate muscles on the paralyzed side compared to the non-paralyzed side, so the interaction between the agonist and antagonist muscles is not well done, and excessive muscle tone and paralysis occur, resulting in poor balance and sensory abilities. Therefore, rehabilitation of stroke patients should focus on improving normal muscle activation and balance for independent ambulation required for activities of daily living [12].

Stroke patients most need improvement in gait function as a result of treatment, so independent ambulation acts as an important factor in patients' lives.

Functional gait performance depends on the patient's physical fitness level, and it is difficult for stroke patients to maintain functional gait speed even for very short distances, since stroke patients can increase their gait speed only by consuming abnormally large amounts of energy [13]. For this reason, intervention methods that increase gait speed and endurance should be applied to rehabilitation treatment of stroke patients. In addition, important factors for effective gait include pelvic rotation, pelvic tilt, ankle joint angle in the stance phase, and muscle activity of muscles around the ankle joint. In particular, it is difficult for stroke patients to actively control the dorsiflexors of the ankle joint due to increased spasticity, and foot drop occurs during walking due to abnormally increased muscle tone in the calf muscle [14].

Gait is a complex process in which the human nervous system and musculoskeletal system are used as a whole, and it is a continuous and repetitive motion in which one lower limb maintains a stable state in the stance phase while the other lower limb simultaneously moves the body. In other words, gait is the result of highly coordinated alternating movements that move the body step by step while maintaining the necessary speed in a constant direction [15]. In the case of hemiplegic patients, it is possible to maintain a certain degree of balance over time, and walking becomes possible when mobility is secured. The most difficult problem for these patients to perform ambulation is their lack of ability to generate a normal amount of voluntary muscle contraction and the inability to match the proper timing and intensity of muscle activity. In addition, in general, patients with the central nervous system are hindered from performing gait due to increased stiffness during voluntary exercise and secondary joint contracture resulting therefrom [16].

The number of subjects in this study was small and the evaluation period was very short, making it difficult to generalize the results. In addition, in this study, since the subject was a human body, cytological evaluation was not performed and various quantitative evaluation methods were not applied. Since extracorporeal shock wave therapy is greatly affected by flow density, frequency, and application area, it is hoped that further research will be conducted to investigate the effect on more various diseases and areas using quantitative methods targeting many patients.

CONCLUSION

In conclusion, walking, which acts as an important factor in social return and quality of life improvement in stroke patients, is difficult to solve by simply applying therapeutic intervention. Therefore, when applying rehabilitation treatment, the treatment method that can reduce the spasticity that causes the limitation of joint mobility and the treatment for muscle strength, endurance, and balance ability

that can increase the walking ability should be applied together. In other words, rehabilitation treatment of stroke patients using overlapping effects between treatments through the application of various treatment methods rather than fragmentary treatment methods should be conducted in clinical practice.

ACKNOWLEDGMENTS

This research was supported by Kyungdong University Research Fund, 2022.

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