Application of Neuromuscular Electrical Stimulation Combined with Weight Loss Treadmill Walking Training in Stroke Patients with Hemiplegia

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Abstract

Objective: To study and analyze the application value of neuromuscular electrical stimulation combined with weight loss treadmill walking training in stroke patients with hemiplegia. Methods: 200 cases of stroke hemiplegia patients admitted to our hospital from April 2020 to December 2022 were randomly divided into study group and control group with 100 cases each. Patients in both groups received conventional drug treatment and basic rehabilitation treatment for stroke hemiplegia. The study group also carried out neuromuscular electrical stimulation combined with weight-loss treadmill walking training for 3 months. The therapeutic effect, the ability of daily living and the improvement of nerve function and motor function were evaluated in the two groups. Results: Post-treatment efficacy evaluation showed that the total effective rate of the study group was higher than that of the control group, and the difference was statistically significant (P < 0.05). After treatment, the ADL scale score of the study group was higher than that of the control group, and the NIHSS scale score was lower than that of the control group, the difference was statistically significant (P < 0.05). After treatment, motor function scores of upper limbs and lower limbs in the study group were higher than those in the control group, and the difference was statistically significant (P < 0.05). Conclusion: Neuromuscular electrical stimulation combined with weight-loss treadmill walking training can effectively improve the therapeutic effect in stroke patients with hemiplegia, and promote the improvement of patients' activities of daily living, neurological function and motor function.

Keywords

Stroke, Hemiplegia, Neuromuscular electrical stimulation, Weight-loss treadmill walking training, Neural function, Motor function

Stroke is a common cerebrovascular lesion in middle-aged and elderly people, which can be divided into cerebral infarction and cerebral hemorrhage according to the type of lesion. The former is common, and the disease is characterized by sudden onset, high risk of disability and death [1]. In the context of the change of disease spectrum, the incidence of stroke is gradually increasing, and the gradual improvement of the emergency medical system has controlled the acute mortality of patients with this disease to a certain extent [2]. Relevant studies [3] show that
nearly 75% of stroke patients will suffer sequelae of varying degrees due to neurological tissue injury, such as hemiplegia, speech disorders, cognitive disorders, etc. The disease burden of stroke sequelae stage patients is mainly drug treatment and rehabilitation treatment, which requires drug intervention to stabilize the underlying disease and professional rehabilitation treatment to promote the improvement of various functional impairments. Help patients return to normal family life as soon as possible. Patients in the sequelae stage of stroke will be affected by the disease with loss of labor force to varying degrees, and time and economic consumption in family care will also increase the disease burden and social burden of patients [4-5]. Therefore, it is of great significance to carry out effective, active and effective treatment for patients with sequelae of stroke. Neuromuscular electrical stimulation is a kind of physical factor therapy that stimulates the cerebral cortex through low-frequency pulse current to improve motor nerve excitability and induce muscle movement, which can effectively improve the function of injured muscle groups of patients [6] and promote the improvement of limb function of hemiplegic side. Weight loss treadmill walking training is a relatively new walking training method, which relies on weight loss support system to carry out training, assist patients to walk [7], and promote the recovery of motor function. In recent years, our hospital has carried out neuromuscular electrical stimulation combined with weight-loss treadmill walking training for some stroke patients with hemiplegia, and the therapeutic effect is satisfactory, as reported below.

1. Data and methods

1.1 General data

200 cases of stroke hemiplegia patients admitted to our hospital from April 2020 to December 2022 were selected and randomly divided into study group and control group, with 100 cases each. There was no statistical difference in general data between the two groups (P > 0.05), as shown in Table 1. Inclusion criteria: (1) Patients who met the diagnostic criteria for stroke [8-9] and had cerebrovascular disease for the first time; (2) patients with secondary stroke hemiplegia; (3) Patients with normal motor function; (4) Actively cooperate with various treatment workers; (5) Complete clinical data. Exclusion criteria: (1) patients with secondary complications other than stroke due to poor control of underlying diseases; (2) abnormal mental condition; (3) Patients with cognitive impairment; (4) Patients with abnormal functions of important organs outside the brain; (5) Patients with malignant tumors.

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender (Male/Female, case)</th>
<th>Age (70.55±13.74)</th>
<th>Underlying disease (16/14/8/6)</th>
<th>MBI (22.44±2.96)</th>
<th>Stroke type (cerebral infarction/cerebral hemorrhage, case)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research group/100</td>
<td>55/45</td>
<td>70.55±13.74</td>
<td>16/14/8/6</td>
<td>22.44±2.96</td>
<td>82/18</td>
</tr>
<tr>
<td>Control group/100</td>
<td>42/48</td>
<td>71.19±14.03</td>
<td>15/15/9/6</td>
<td>22.71±3.31</td>
<td>84/16</td>
</tr>
</tbody>
</table>

| χ²/t                   | 1.316                       | 0.326              | 0.114                         | 0.608            | 0.142                                                   |
| P                      | 0.251                       | 0.745              | 0.990                         | 0.544            | 0.707                                                   |

1.2 Method

1.2.1 Control group

Conventional drug therapy and basic rehabilitation therapy for stroke hemiplegia were carried out, and intervention with nutritional nerve, fluid supplement and anti-inflammatory drugs were given. Rehabilitation programs were developed after joint ward rounds by rehabilitation physicians and neuro physicians to evaluate the overall situation of patients, mainly including hemiplegia side limb massage, sports rehabilitation training, etc. Rehabilitation treatment was carried out based on patients' individual conditions, lasting for 3 months.

1.2.2 Study group

On the basis of control group, neuromuscular electrical stimulation combined with weight-loss treadmill walking training was carried out for 3 months, as follows:

(1) Neuromuscular electrical stimulation: neuromuscular electrical stimulation therapy instrument was used for
treatment, and the electrodes were disinfected. The anode was fixed in the dorsolateral cortex of the frontal lobe on the hemiplegic side, and the cathode was fixed in the contralateral supraorbital region. The frequency was 2-14Hz, and the intensity was adjusted according to the patient's tolerance. Each treatment was 20min, once a day.

(2) Weight loss treadmill walking training: weight loss support system was adopted to carry out training, and 30~50% of body weight was lost. The initial speed was set at 0.2km/h and the slope was 0°. After walking for 5 minutes, the exercise was repeated with a rest for 2~3 minutes, once a day, as long as patients could tolerate it. Gradually extend the walking time and reduce the weight ratio.

1.3 Observation index

1.3.1 Evaluation of therapeutic effect

According to the improvement of Neurologic impairment score (NIHSS) and self-care ability before and after treatment, the therapeutic effect was evaluated. After treatment, the NIHSS score of the patients was reduced by 90% or more. NIHSS decreased by 45~ < 90%, life needs some assistance, part of the effective self-care; Failure to meet the relevant standards is invalid.

1.3.2 Evaluation of activities of daily living and neurological function

Activity of Daily Living (ADL) and NIHSS scale were used to assess the patients' activities of daily living and neurological function at two stages before and after treatment. The total score of ADL scale was 100, and the higher the score, the better the recovery of activities of daily living, the 42 points of NIHSS scale. > 1 is classified as abnormal neurological function, the higher the score, the more serious the neurological function damage.

1.3.3 Motor function assessment

Before and after treatment, the simple Gel Meyer Motor Scale (FMA) was used to evaluate the motor function of each patient, which was mainly evaluated from the motor function of upper limb and lower limb. The total score of motor function of upper limb was 0~66, and the total score of motor function of lower limb was 0~34. The higher the score is, the better the functional recovery is.

1.4 Statistical methods

SPSS23.0 statistical software was used for processing, measurement data were expressed as (x ± s), comparison was performed by t test, count data were expressed as percentage, comparison was performed by $\chi^2$ test, $P < 0.05$ was considered statistically significant.

2. Results

2.1 Comparison of the treatment effect between the two groups

Post-treatment efficacy evaluation showed that the total effective rate of the study group was higher than that of the control group, with statistical significance ($P < 0.05$), as shown in Table 2.

<table>
<thead>
<tr>
<th>Group</th>
<th>Apparent effect</th>
<th>Effective</th>
<th>Void</th>
<th>Total effective rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research group/100</td>
<td>51(51.00)</td>
<td>45(45.00)</td>
<td>4(4.00)</td>
<td>96(96.00)</td>
</tr>
<tr>
<td>Control group/100</td>
<td>33(33.00)</td>
<td>52(52.00)</td>
<td>15(15.00)</td>
<td>85(85.00)</td>
</tr>
</tbody>
</table>

$\chi^2$ 7.037  
$P$ 0.008

2.2 Comparison of activities of daily living and neurological function between the two groups

After treatment, the ADL scale score of the two groups increased, while the NIHSS scale score of the two groups decreased, with statistical significance compared with before treatment ($P < 0.05$). The ADL scale score of the study group was higher than that of the control group, while the NIHSS scale score was lower than that of the control group, with statistical significance ($P < 0.05$), as shown in Table 3.
Table 3. Comparison of activities of daily living and neurological function between the two groups ( \( \bar{x} \pm s \) )

<table>
<thead>
<tr>
<th>Group</th>
<th>ADL scale (points)</th>
<th>NIHSS scale (points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-treatment</td>
<td>After treatment</td>
</tr>
<tr>
<td>Research group/100</td>
<td>58.10±5.61</td>
<td>77.23±4.94*</td>
</tr>
<tr>
<td>Control group/100</td>
<td>58.42±6.12</td>
<td>67.39±5.05*</td>
</tr>
<tr>
<td>t</td>
<td>0.385</td>
<td>13.929</td>
</tr>
<tr>
<td>P</td>
<td>0.700</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Note: Compared with before treatment, *P < 0.05

2.3 Comparison of motor function between the two groups

After treatment, the motor function scores of the upper limb and lower limb of the FMA scale in the two groups were increased, and the difference before treatment was statistically significant (P < 0.05). The motor function scores of the upper limb and lower limb of the FMA scale in the study group were higher than those in the control group, and the difference was statistically significant (P < 0.05), as shown in Table 4.

Table 4. Comparison of motor function scores of upper limb and lower limb on FMA scale between the two groups ( \( \bar{x} \pm s \) )

<table>
<thead>
<tr>
<th>Group</th>
<th>Upper limb function score (points)</th>
<th>Lower limb function score (points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-treatment</td>
<td>After treatment</td>
</tr>
<tr>
<td>Research group/100</td>
<td>30.12±4.12</td>
<td>49.52±5.41*</td>
</tr>
<tr>
<td>Control group/100</td>
<td>31.23±4.53</td>
<td>44.21±4.92*</td>
</tr>
<tr>
<td>t</td>
<td>1.813</td>
<td>7.261</td>
</tr>
<tr>
<td>P</td>
<td>0.071</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Note: Compared with before treatment, *P < 0.05

3. Discussion

In the context of disease structural transformation, the incidence of stroke shows an increasing trend and occupies a major position in the global disease burden. The high incidence of stroke is associated with the increased incidence of chronic diseases such as hypertension, diabetes and hyperlipidemia [10]. Stroke is mainly divided into cerebral infarction and cerebral hemorrhage. The occurrence of cerebral infarction is related to lipid deposition, while the occurrence of cerebral hemorrhage is mainly related to cerebral parenchymal lesions induced by rupture of intracranial arteries and veins, etc. The increasing incidence in recent years has caused a great burden on the medical and health system [11-12]. The occurrence of stroke is closely related to the sustained development of underlying diseases. In the course of the disease development, cerebral artery hyaline degeneration and lipid deposition in the vascular intima will be accompanied, and various factors will stimulate and induce cerebrovascular rupture or cerebrovascular obstruction. Cerebral hemorrhage is the most serious type of stroke, with high mortality and disability rates of patients, often accompanied by serious circulatory, respiratory and other multi-system functional impairment. Most cases need to be transferred to intensive care unit for treatment [13], and patients and their families bear a heavy medical burden. Stroke patients in the sequelae stage need to be transferred to the rehabilitation department to receive rehabilitation treatment, which is also a key stage of the whole course of treatment. To ensure the effect of drug therapy is the basic premise of rehabilitation treatment, and on this basis to promote the recovery of dysfunction and guarantee the prognostic effect is also extremely critical. This study mainly analyzed the effect of the combined application of neuromuscular electrical stimulation and weight-loss treadmill walking training, and showed that after 3 months of treatment, the total effective rate of patients in the study group was higher than that in the control group, and this combined intervention therapy can effectively promote the control of stroke hemiplegia. After treatment, the ADL scale score of the study group was higher than that of the control group, the NIHSS scale score was lower than that of the control group, the motor function scores of the upper limb and lower limb of the FMA scale were higher than that of the control group, and the functional recovery of the study group was better.
than that of the control group. In neuromuscular electrical stimulation, the cerebral cortex is electrically stimulated by low-frequency pulse current to induce changes in resting membrane potential. The excitability of neurons is enhanced by anode depolarization, while the excitability of the cathode can be reduced. This cyclic process can promote nerve reflex and accelerate the remodeling of neurons, improve nerve function, and further promote the recovery of limb function on hemiplegic side. Weight loss plank walking training relies on weight loss support system training to lose weight, and drives limb movement under plate rotation. During walking training, hip joint stretching and ankle joint flexion can be carried out to improve muscle function and joint motion. The combined application of neuromuscular electrical stimulation and weight-loss treadmill walking training can play a good synergistic effect, complement each other and promote the recovery of patients with dysfunction.

In summary, neuromuscular electrical stimulation combined with weight loss treadmill walking training has outstanding value in improving the efficacy and improving the activities of daily living, nerve function and motor function in stroke patients with hemiplegia, and is worth carrying out.

References


