Research on the Effect of Functional Electrical Stimulation (FES) on Abnormal Lower Limb Movement Patterns in Stroke Patients Based on Surface Electromyography

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Abstract: Objective: To observe the effect of multi-channel functional electrical stimulation (FES) treatment on stroke patients with abnormal lower limb movement. Methods: Sixty-six stroke patients with abnormal lower limb movement in our hospital from February to December 2024 were selected as the research subjects and randomly divided into two groups. One group (33 cases) received conventional treatment (control group), and the other group (33 cases) received FES treatment (observation group). The lower limb function, daily activity ability, balance ability, and movement distance of the patients were compared. Results: The lower limb function and daily activity ability of the observation group were higher than those of the control group after treatment, with <0.05. The balance ability and movement distance of the observation group were also higher than those of the control group after treatment, with P<0.05. Conclusion: FES treatment for stroke patients with abnormal lower limb movement can improve the patients' lower limb function, increase their daily activity ability, and improve their balance ability and movement distance.

Keywords: FES; Stroke; Abnormal Lower Limb Movement

1. Introduction

Stroke is currently a major cerebrovascular disease that affects the health of the elderly. It has a high incidence rate in clinical practice and poses a high risk, which may even threaten the lives of patients. Most of these patients have varying degrees of damage to their nervous system function, resulting in different types of motor function disorders. Among them, lower limb motor function disorders are the most common, which directly affect the prognosis of patients [1-2]. The treatment of these patients with FES has gradually been applied in clinical practice. This study mainly aimed to observe the effect of FES treatment on stroke patients with abnormal lower limb movement.

2. Materials and Methods

2.1 General Information

Sixty-six stroke patients with abnormal lower limb movement in our hospital from February to December 2024 were selected as the research subjects and randomly divided into two groups. One group (33 cases) received conventional treatment (control group), and the other group (33 cases) received FES treatment (observation group). In the control group, there were 17 males and 16 females, with an age range of 61-78 years and an average age of (64.36 ± 1.85) years. The body mass index (BMI) ranged from 21 to 24 kg/m², with an average of (22.35 ± 1.05) kg/m². In the observation group, there were 18 males and 15 females, with an age range of 62-79 years and an average age of (64.45 ± 1.12) years. The BMI ranged from 21 to 24 kg/m², with an average of (22.45 ± 1.04) kg/m². There was no significant difference in the basic data of stroke cases between the two groups (P > 0.05).

2.2 Methods

Patients in the control group received conventional rehabilitation treatment during the recovery period. Rehabilitation physicians assisted the patients in performing lower limb functional exercises, such as flexion and extension, and gradually guided the patients to perform active rehabilitation training according to their recovery conditions. The single training time was controlled at about 30 minutes, twice a day. For patients who met the conditions for getting out of bed, they were assisted to get out of bed and move as early as possible.

Patients in the observation group received FES treatment during the recovery period. The

patients were guided to lie in the healthy-side decubitus position, and the affected lower limb was appropriately suspended. The electrode patches were attached to the anterior tibial muscle, the lateral quadriceps femoris muscle, and the lateral biceps femoris muscle of the patients respectively. During the treatment, the frequency was set at 30Hz, the pulse width was set at 200 μ s, the cycle was set at 5s, and the intensity was controlled according to the patients' tolerance. The single-treatment time was 30 minutes, once a day.

2.3 Observation Indicators

(1) Evaluation of lower limb function and daily activity ability: The lower limb function of the patients before and after treatment was evaluated using the Fugl-Meyer Assessment (FMA) scale. The lower limb part of this scale consists of 17 items with a total score of 34 points. The higher the score, the better the lower limb function of the patients. The functional ambulation category (FAC) scale was used to evaluate the activity ability of the patients, with a score range of 0-5 points. The higher the score, the better the lower limb function.

(2) Analysis of balance ability and movement distance: The Berg balance scale was used to evaluate the balance ability of the patients, with a score range of 0-56 points. The higher the score, the better the balance ability of the patients. The movement distance was tested by the 6-minute walk test, and the tests were carried out before and after treatment respectively.

2.4 Statistical Methods

The relevant data in the study were analyzed by SPSS 25.0. Measurement data were expressed as mean ± standard deviation and tested by t-test. Count data were expressed as percentage and tested by chi-square test. $P<0.05$ indicated that the difference was statistically significant.

3. Result

3.1 Comparison of Lower Limb Function and Daily Activity Ability

The lower limb function and daily activity ability of the observation group were higher than those of the control group after treatment, with $P < 0.05$, as shown in Table 1.

Table 1. Comparison of Lower Limb Function and Daily Activity Ability ($\bar{x} \pm s$)

Group	Number of Cases	Lower Limb Function		Daily Activity Ability	
		Before Treatment	After Treatment	Before Treatment	After Treatment
Observation Group	33	16.85±2.11	28.63±1.32	2.04±0.35	3.88±0.15
Control Group	33	16.91±2.22	21.06±1.67	2.06±0.28	2.64±0.22
t	-	1.428	28.045	1.758	28.425
p	-	0.611	0.001	0.364	0.001

3.2 Comparison of Balance Ability and Movement Distance

The balance ability and movement distance of the observation group were higher than those of the control group after treatment, with $P < 0.05$, as shown in Table 2.

Table 2. Comparison of Balance Ability and Movement Distance ($\bar{x} \pm s$)

Group	Number of Cases	Balance Ability		Movement Distance	
		Before Treatment	After Treatment	Before Treatment	After Treatment
Observation Group	33	22.35±2.35	41.45±1.98	226.45±10.05	436.45±13.45
Control Group	33	22.46±2.45	31.64±2.05	227.64±9.44	324.64±10.45
t	-	1.578	27.452	1.052	36.425
p	-	0.326	0.001	0.152	0.001

4. Discussion

Stroke is difficult to treat and has a great negative impact on the health and prognosis of patients. Most of these patients have varying degrees of functional impairment, and lower limb functional impairment is the most common type, which directly affects the patients' subsequent lives [3-4]. During the treatment of stroke patients, more effective rehabilitation treatment plans are needed to help restore the lower limb function of patients.

FES is currently the main rehabilitation treatment measure for patients with limb dysfunction after stroke in clinical practice. Under this treatment plan, it can correct the gait

of patients, stimulate four groups of muscles in the lower limbs of patients, simulate the normal walking pattern, and improve the coordination of lower limb muscle groups and joints. Moreover, under the effect of continuous treatment, it can increase the activity of lower limb muscle cells, improve the local microcirculation, relieve symptoms such as lower limb muscle spasm, and help restore the damaged function [5-6]. At the same time, this treatment method is non-invasive and highly safe, and will not cause discomfort to patients during the treatment process. It can be used in the treatment of almost all stroke patients with lower limb dysfunction. In this study, the observation group received FES treatment during the rehabilitation period. Through observation, it can be seen that compared with the conventional rehabilitation treatment plan, FES treatment can improve the lower limb function of patients, enhance their activity ability, improve their balance ability, and increase their 6-minute walking distance, which plays an important role in helping patients recover.

In conclusion, during the rehabilitation treatment of stroke patients with abnormal lower limb movement, FES treatment can be carried out to help restore the damaged function of patients and improve their prognosis.

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