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The Influence of Early Extensor Rehabilitation Therapy on the Functional Recovery of Hemiplegic Upper Limbs During the Recovery Period of Cerebral Infarction

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Abstract: *Objective*: To explore the effect of early extensor rehabilitation therapy in patients with upper limb hemiplegia during the recovery period of cerebral infarction. *Method*: A total of 78 patients with upper limb hemiplegia during the recovery period of cerebral infarction were included as the research subjects and all received treatment in our hospital from January 2024 to December 2024. The groups were grouped by double-blind method, with 39 cases in each group. The control group and the observation group received early flexor rehabilitation treatment and early extensor rehabilitation treatment respectively. The upper limb function and self-care ability of the two groups before and after treatment were compared. *Result*: After the intervention, the upper limb motor function score of the observation group was significantly higher than that of the control group, $P < 0.05$; After treatment, the Barthel index of the observation group was significantly increased compared with that before treatment, and there was a significant difference compared with the control group, $P < 0.05$. *Conclusion*: The implementation of early extensor rehabilitation therapy for patients in the recovery period of cerebral infarction with hemiplegia of the upper limbs can effectively promote the recovery of upper limb function and improve their self-care ability in life, which is worthy of clinical promotion.

Keywords: Upper limb hemiplegia; The recovery period of cerebral infarction; Early extensor rehabilitation treatment; Upper limb function

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1. Introduction

Cerebral infarction is a common clinical disease. Its occurrence is related to insufficient blood supply to the brain, which leads to ischemia, hypoxia and necrosis of the central nervous system tissue, thereby causing functional disorders in the innervated areas [1]. Hemiplegia is a common complication after cerebral infarction, with upper limb hemiplegia being particularly common, which has a huge impact on patients' daily lives. It is understood that approximately 60% to 80% of patients in the recovery period of cerebral infarction have varying degrees of

upper limb dysfunction. If not treated promptly and effectively, it can affect the recovery of upper limb function and even leave permanent disability [2,3]. At present, there are many methods for treating hemiplegia after cerebral infarction in clinical practice, including limb function training, acupuncture physiotherapy, neuro-muscle electrical stimulation, etc. However, many of these methods pay more attention to the recovery of flexor muscle function and neglect the training of extensor muscle function, thereby affecting the rehabilitation effect [4,5]. Therefore, more efficient treatment methods should be actively explored to enhance the effectiveness of rehabilitation. This study selected 78 patients with upper limb hemiplegia after cerebral infarction as samples to explore the clinical value of early extensor rehabilitation therapy.

2. Materials and methods

2.1. Basic information

A total of 78 patients in the recovery period of cerebral infarction were included as the research subjects, all of whom had hemiplegia of the upper limbs. All patients received relevant treatments in our hospital from January 2024 to December 2024. During the research process, the patients were divided into the control group and the observation group by a double-blind method. Among the 39 patients in the control group, there were 23 males and 16 females. The youngest was 45 years old and the oldest was 78 years old, with a median value of (62.35 ± 5.87) years old. Among the 39 patients in the observation group, there were 22 males and 17 females. The youngest was 43 years old and the oldest was 80 years old, with a median value of (63.25 ± 5.16) years old. The comparison of basic data between the two groups of patients showed no statistical significance ($P > 0.05$). This study was approved by the hospital ethics committee.

Inclusion criteria: (1) All patients were confirmed to have cerebral infarction by cranial CT or magnetic resonance imaging. (2) All patients were in the recovery period (14 to 180 days after the onset of the disease). (3) There is unilateral upper limb dysfunction. After Fugl-Meyer assessment of motor function, the functional score of the affected upper limb is between 10 and 45 points. (4) The patient's cognitive function is normal and can cooperate with rehabilitation treatment.

Exclusion criteria: (1) Those with combined dysfunction of important organs; (2) Those with combined upper limb fractures, joint deformities, inflammatory responses or other severe diseases of the musculoskeletal system; (3) Those with abnormal coagulation mechanisms; (4) Others who cannot cooperate with rehabilitation treatment; (5) Those with recurrent conditions or those with other serious complications.

2.2. Methods

All patients received symptomatic and supportive treatments such as blood pressure reduction, blood sugar reduction, lipid regulation, anti-platelet aggregation, improvement of cerebral circulation, and nerve nutrition. On this basis, different rehabilitation treatment measures were given to the two groups of patients.

The control group received early flexor rehabilitation treatment:

(1) Active flexor training: Guided patients to actively carry out contraction exercises of the flexor muscles of the affected upper limb, including forward flexion of the shoulder joint, flexion of the elbow joint, palmarion of the wrist joint, flexion and grasping of the fingers, etc. During the training process, professional rehabilitation instructors will provide guidance to ensure that each movement is correct and in place. Each movement should be maintained for 5 to 10 seconds, and repeated 10 to 15 times as a set. Each training session lasts for 20 minutes, with 2 repetitions per day.

(2) Flexor resistance training: Flexor resistance training can only be carried out after the flexor strength of the affected upper limb has recovered to grade 4 or higher. During the training process, elastic bands are used as resistors to guide patients to flex their fingers and forearms while resisting resistance. During the training process, the resistance of the elastic band can be adjusted according to the patient's muscle strength, 20 minutes per session, twice a day.

(3) Coordination training: Guide the patient to alternately perform flexion and extension training of the wrist joint, finger joint, and elbow joint to improve their coordination ability and movement accuracy gradually. Each session lasts for 15 minutes, twice a day. The above training should be carried out every day for 8 consecutive weeks.

The observation group received early extensor rehabilitation treatment:

(1) Active extensor training: Guided patients to actively complete the contraction training of the upper limb extensor muscles, including posterior extension of the shoulder joint, extension of the elbow joint, dorsiflexion of the wrist joint, and posterior extension of the fingers, etc. Also guided by a rehabilitation therapist, incorrect movements are corrected in a timely manner to ensure they are in place. Each movement should be maintained for 5 to 10 seconds. Each set consists of 10 to 15 repetitions, with each session lasting 20 minutes, performed twice a day.

(2) Extensor resistance training: Extensor resistance training should be initiated when the strength of the extensor muscles on the affected upper limb reaches grade 4 or above. During training, patients need to complete extensor muscle training for various parts of the upper limbs, including the shoulder, elbow, wrist, finger and other joints, while resisting resistance. Elasticity should be appropriately adjusted according to the individual's muscle recovery condition to promote the slow recovery of muscle strength.

(3) Extensor coordination training: Guide patients to alternately perform actions such as dorsal extension of the affected wrist joint and flexion and extension of the elbow joint to enhance the coordination of movements. 10 to 15 times per group, 15 minutes each time, twice a day.

(4) Homework training: Guide patients to carry out targeted extensor muscle function exercises based on their daily life needs, such as pushing tables, opening doors, lifting heavy objects, and wring out towels with the affected palm, to promote the improvement of their extensor muscle function and self-care ability in daily life. The above training should be carried out every day for 8 consecutive weeks.

2.3. Index observation

2.3.1. Upper limb motor function

The assessment was completed through the upper limb part of the Fugl-Meyer Assessment of Motor Function Scale, including reflex activity, coordinated activity of flexor and extensor muscles, activities with and without coordinated movement, hyperreflexia, wrist stability, elbow extension, and forward flexion at 30°. There were a total of 33 items, with scores ranging from 0 to 66 points, and the scores were negatively correlated with functional disorders. The measurement time was before treatment and after the completion of the 8-week training.

2.3.2. Self-care ability

The assessment of self-care ability is completed through the modified Barthel Index scale, including dressing, eating, washing, walking, using the toilet, going up and down stairs, etc. It is scored out of 100, and the score is positively correlated with self-care ability. The measurement time was before treatment and after the completion of the 8-week training.

2.4. Statistical analysis

SPSS 24.0 software was applied. Measurement data were expressed as mean ± standard deviation (SD), and count data were expressed as (%). The former was tested by t-test and the latter by chi-square test. When $P < 0.05$, it is statistically significant.

3. Results

3.1. Comparison of upper limb motor functions

Comparison of upper limb motor function scores: After treatment, the values of the observation group were higher, $P < 0.05$. See **Table 1**.

Table 1. Comparison of upper limb motor function (mean ± SD, points)

Group	Number of cases	Before treatment	After treatment
Control group	39	27.82 ± 6.51	45.24 ± 7.65
Observation Group	39	28.35 ± 6.42	58.76 ± 8.32
t		0.632	7.470
P		0.718	0.000

3.2. Comparison of self-care ability

The comparison of the Barthel index shows that the value of the observation group is higher, with $P < 0.05$. See **Table 2**.

Table 2. Comparison of Barthel index between the two groups (mean ± SD, points)

Group	Number of cases	Before treatment	After treatment
Control group	39	41.82±8.71	62.15±8.73
Observation Group	39	42.35±8.62	76.38±9.51
t		0.270	6.883
P		0.788	0.000

4. Discussion

Cerebral infarction, also known as ischemic stroke, is mainly caused by the narrowing or occlusion of cerebral blood vessels, resulting in ischemia, hypoxia and necrosis of brain tissue, thereby causing neurological dysfunction [6,7]. Upper limb hemiplegia is one of the most common complications of cerebral infarction. As the upper limb involves the coordinated movement of multiple joints and muscles, and after the onset of the disease, it is prone to conditions such as extensor muscle weakness and flexor muscle spasm in the upper limb, the difficulty of functional recovery is even greater. Studies have shown that the recovery period is a crucial time for the recovery of neurological function in patients with cerebral infarction [8,9]. Timely and effective rehabilitation treatment can promote brain tissue remodeling and the reorganization of the nervous system, helping patients restore their neurological and motor functions. However, in conventional rehabilitation training, flexor muscle training is the main focus. Although it can improve nerve spasm, extensor muscles cannot be effectively trained, resulting in many patients

still having problems such as extensor muscle weakness and insufficient coordination ability after rehabilitation, thereby affecting the overall recovery of the limbs [10,11].

In this study, after the observation group received early extensor training, the upper limb motor function score and Barthel index score of the patients in this group were significantly improved compared with those before treatment, and there was a significant difference from the control group ($P < 0.05$), suggesting that this training method is beneficial to the recovery of upper limb motor function and self-care ability of the patients. The main reasons are as follows:

(1) Through active training, resistance training and coordinated training of extensor muscles, the strength and endurance of the extensor muscles on the affected side can be effectively enhanced, the force balance between extensor and flexor muscles can be improved, muscle spasms can be alleviated, and thus the motor function of the upper limbs can be improved [12]. For instance, extensor resistance training can gradually increase resistance to promote the proliferation and differentiation of extensor muscle fibers, thereby achieving a gradual improvement in muscle strength. Extensor coordination training can enhance the regulatory effect of the cerebral motor cortex on extensor muscle strength and improve the coordinated cooperation of extensor and flexor muscles [12].

(2) The organic combination of extensor function training and occupational training helps patients enhance their self-care ability in practical application, further stimulates their confidence in recovery, and increases their enthusiasm for training, thereby achieving an improvement in their self-care ability in daily life [13,14]. For instance, practicing actions such as pushing a table and opening a door with the affected hand can help patients skillfully apply extensor muscle strength in their daily lives, achieving a common improvement in extensor muscle and self-care ability.

(3) The implementation of early extensor rehabilitation training can improve the microcirculation in the area around the lesion after cerebral infarction, enhance local blood supply, promote the repair and regeneration of nerve cells, accelerate the remodeling of nerve function, and thereby facilitate the recovery of motor function in hemiplegic limbs [15].

5. Conclusion

In conclusion, implementing early extensor rehabilitation treatment for patients in the recovery period of cerebral infarction with hemiplegia of the upper limbs is beneficial to the recovery of their upper limb motor function and self-care ability, and is worthy of promotion.

Disclosure statement

The authors declare no conflict of interest.

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