

Study on the effect of rehabilitation therapy based on deep learning on functional recovery of stroke patients with hemiplegia

Xuefei HAN¹, Yongmei Yan^{2*}

¹. Shaanxi University of Chinese Medicine, Xianyang, Shaanxi 712046, China

²Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, Xianyang, Shaanxi 712000, China

*corresponding author

Abstract: *Objective:* Based on deep learning, to explore the clinical effect of early rehabilitation intervention management model on the recovery of neurological function in patients with acute stroke. *Methods:* A total of 86 inpatients in our department from June 2019 to August 2020 were selected. According to the ward distribution, the hospital was randomly divided into routine drug treatment group (control group, 44 cases) and another ward was divided into early comprehensive rehabilitation treatment group (treatment group, 42 cases). The treatment group received regular rehabilitation training in addition to clinical medication, while the control group received clinical medication and self-exercise without guidance. They were evaluated 24 hours before treatment and 7-10 weeks after treatment. The motor function was evaluated by Furl—Meyer motor function integral method (FMA), and the daily living ability was scored by Barthel index. *Results:* There was no significant difference in Barthel index and FMA score between the treatment group and the control group before treatment. After treatment, the two indexes in the control group improved to a certain extent, but compared with the treatment group, the improvement degree was far less than that in the treatment group, and the difference was statistically significant ($P < 0.01$). The effective rate and total effective rate in the treatment group were significantly higher than those in the control group, with statistical difference between the two groups ($P < 0.05$). *Conclusion:* Early rehabilitation intervention management model can effectively improve the neurological function of patients with acute stroke and improve the clinical efficacy, which is worthy of further promotion and use in clinical practice.

Keywords: Deep learning; Rehabilitation treatment; Stroke patients with hemiplegia; Function recovery

1. Introduction

It has been reported in literature that the incidence of hemiplegia after stroke is as high as 75% [1]; Hemiplegia is not only a medical problem, but more importantly, it is increasingly becoming a serious social problem, which not only seriously affects the quality of life of patients, but also brings a heavy burden to families and society. Stroke sequela brings heavy economic and psychological burden to patients, which seriously affects their quality of life. [2] The research of the center has confirmed that rehabilitation therapy has a good clinical effect on reducing the disability rate of stroke.

At present, most scholars advocate that rehabilitation should be carried out as soon as possible after stroke. In order to explore the effect of early rehabilitation treatment on functional recovery of upper and lower limbs and activities of daily living of stroke patients with hemiplegia, the author conducted the following clinical comparative study on patients with acute stroke based on deep learning.

2. Literature review on rehabilitation treatment of stroke

Stroke, also known as cerebrovascular accident, was once called stroke, which refers to a sudden clinical syndrome of limited or whole brain dysfunction caused by cerebrovascular disease, lasting more than 24 hours or causing death. It has the characteristics of high incidence, high recurrence rate, high disability rate and high mortality rate, and is one of the most important fatal and disabling diseases in the world [3]. The rehabilitation mechanism of stroke is still unclear, so it has always been an

important topic in rehabilitation medicine research. In recent years, with the development of neuroimaging, people have more basis for judging the prognosis of stroke and choosing the time of early rehabilitation. Generally, stroke rehabilitation can be classified into functional rehabilitation in injured area and functional rehabilitation in distant area.

The prevention, treatment and rehabilitation of stroke is a systematic project. It is necessary to enhance public awareness, strengthen self-management and strengthen the prevention of cerebrovascular diseases. Stroke is preventable and controllable, so we should continue to control the risk factors of cerebrovascular disease. At present, it is believed that the rehabilitation treatment of stroke should start at an early stage, and the earlier intervention, the better the effect. Generally, the best recovery period is within 3 months after onset. Because the aggravation of stroke in the first few days coexists with natural recovery, the degree of recovery in the early stage (usually within one month after the onset) is greater than the degree of aggravation [4-5]. By promoting the upper center's control of movement, abnormal and primitive reflex activity can be suppressed, the patient's movement pattern can be improved, the formation of spasm can be resisted, the normal movement pattern can be reorganized, and the muscle strength of the affected limb can be enhanced. Rehabilitation treatment is a gradual process with a certain continuity. Patients should also receive family training or community rehabilitation training after returning to their families.

Modern rehabilitation theory and practice have proved that effective rehabilitation training can reduce patients' functional disability, improve patients' satisfaction, accelerate the rehabilitation process of stroke, reduce potential nursing expenses and save social resources [6]. Longhi et al. [7] think that functional reorganization can be divided into intra-system reorganization and inter-system reorganization, which shows that the reason why the brain has high plasticity is not the regeneration of neurons, but the result of dynamic functional reconstruction. This theory of functional reorganization has become the scientific basis of neurological rehabilitation after stroke. Cui Zhihui [8] conducted a prospective multicenter randomized controlled study on tertiary rehabilitation for acute cerebrovascular disease, which showed that tertiary rehabilitation can enable patients to obtain better motor function, ADL and quality of life and reduce complications [9]; Community and/or family rehabilitation is also an important part of stroke rehabilitation, which is being paid more and more attention. For stroke patients discharged earlier or returning to their families, they should continue rehabilitation at home under the guidance of the hospital neurological rehabilitation team, and pay attention to keeping close contact with patients and regular follow-up to ensure the treatment effect.

Early rehabilitation intervention can not only improve the depression symptoms of stroke patients, but also play a positive role in the rehabilitation of motor function, which has definite clinical application value. Therefore, the vast majority of patients with stroke sequelae must pass community rehabilitation treatment, which has basically become the most important rehabilitation way and method for stroke patients [10]. At present, there is still one of the most important factors affecting the post-treatment and rehabilitation of stroke patients, that is, most stroke patients can not get an effective discharge plan after discharge [11]. In order to establish a perfect and standardized three-level rehabilitation treatment system, it is necessary to strengthen and train community rehabilitation talents and establish a sound three-level medical referral system.

3. Materials and methods

3.1. General information

A total of 86 inpatients in our department from June 2019 to August 2020 were selected. According to the ward distribution, the hospital was randomly divided into routine drug treatment group (control group, 44 cases) and another ward was divided into early comprehensive rehabilitation treatment group (treatment group, 42 cases). All of them meet the diagnostic criteria adopted by the academic conference on cerebrovascular diseases, and all of them are confirmed as acute patients with first onset by CT or MRI examination; All patients had limb paralysis, but no aphasia, severe mental retardation, and no neurological or musculoskeletal diseases affecting functional recovery. The scores of neurological deficits ranged from 6 to 40.

3.2. Method

Patients in both groups received routine medication in neurology department in acute stage. After the vital signs of the treatment group were stable, rehabilitation treatment was started, and exercise therapy, occupational therapy and electrotherapy were used. Exercise therapy is mainly combined with exercise relearning and Bobath therapy, which is gradual according to the characteristics of stroke dysfunction. For lonely patients, nursing staff should understand the reasons of loneliness, keep communication with patients frequently, be kind, help patients from family and society, make them feel

the warmth of family and society, and gradually help patients get out of loneliness.

The arrangement of training time: exercise therapy once a day, 45min each time, 5 times a week; Electrotherapy time is once a day, 20min each time, 5 times a week. No rehabilitation treatment was given to the control group, but some patients moved by themselves under the oral sting of clinicians, and some patients' families helped patients move according to their own understanding.

Ability training of daily living activities, including wearing clothes, shoes and socks, eating, going to the toilet, brushing teeth, etc., every 133 ~ 4 times, 30min; each time; Walking and going up and down stairs training, focusing on the weight-bearing capacity of hemiplegic limbs and the functions of knee flexor and ankle dorsiflexion, once or twice a day for 30rain each time.

3.3. Evaluate

Barthel index was used to evaluate the functional recovery of upper and lower limbs and the ability of daily living in stroke patients with hemiplegia Fugl—Meyer motor function integral method was used to evaluate limb motor function. The first evaluation was conducted 24 h before treatment, and the second evaluation was conducted by the same doctor 7~ 10weeks after treatment. The FMA score is 66 for upper limbs and 34 for lower limbs. For comparison, the FMA scores of upper and lower limbs were converted into the percentage of maximum movement. The evaluation results were expressed as mean standard deviation and percentage, and were statistically processed by T test.

3.4. Limb motion recognition

Facial action recognition includes two aspects: first, blink action recognition; The second is mouth motion recognition. The main idea of facial motion recognition is to train before using. Training means that before the patient uses the system, the system needs to train the threshold of blinking and opening and closing recognition according to the images of the patient's eyes opening, closing, opening and closing.

The existing algorithms recognize eye movements according to the roughness of image gray scale, and recognize mouth movements according to the brightness of image. In the training process of blink threshold, firstly, the eye region is cut out from the face image, then it is transformed into a gray image, and finally the roughness of the gray image is calculated according to formula (1).

$$\sigma = \frac{\sum_x \sum_y^M (A(x, y) - \mu)^2}{M \times N} \quad (1)$$

In formula (1), M and N are the size of the image, where $M = 30, N = 20$, $A(x, y)$ are the pixel values at the coordinate (x, y) in the image, and σ is the calculated gray level roughness.

In the training process of opening and closing threshold, firstly, the mouth region is cut out from the face image, then it is converted into a gray image, and finally the brightness of the gray image is calculated according to formula (2).

$$\mu = \frac{\sum_x \sum_y^M A(x, y)}{M \times N} \quad (2)$$

In formula (2), $M = 70, N = 30$ and μ are the brightness of gray image.

4. Result

4.1. Comparison of Barthel index and Fugl-Meyer score in stroke patients with hemiplegia before and after treatment

There was no significant difference in Barthel index and FMA score between the treatment group and the control group before treatment. After treatment, the two indexes in the control group improved to a certain extent, but compared with the treatment group, the improvement degree was far less than that in the treatment group, and the difference was statistically significant ($P < 0.01$), as shown in Table 1.

Table 1 Comparison of Barthel index and Fugl-Meyer score in stroke patients with hemiplegia before and after treatment($\bar{x} \pm s$)

Group	Number of cases	Barthel index		Fugl-Meyer integral			
		Before treatment	After treatment	Before upper limb treatment	After upper limb treatment	Before treatment of lower limbs	After lower limb treatment
Control group	44	32.07±10.28	60.23±15.66	10.02±2.17	21.45±7.60	6.62±3.38	13.28±5.70
Treatment group	42	30.15±12.60	58.72±18.93*	9.93±2.86	37.81±9.14*	6.82±3.07	21.48±7.93*

Note: Compared with the control group, * P < 0.01

4.2. Comparison of clinical efficacy between two groups of patients after rehabilitation treatment

The effective rate and total effective rate in the treatment group were significantly higher than those in the control group, with statistical difference between the two groups (P<0.05), as shown in Table 2.

Table 2 Comparison of clinical efficacy between two groups of patients after rehabilitation treatment (n/%)

Group	Number of cases	Be almost recovered	Show effect	Effective	Be invalid	Total effective rate
Control group	44	3/6.82	27/61.36	11/25.00	2/4.55	43/97.73
Treatment group	42	2/4.55	16/38.10	14/33.33	4/9.52	36/85.71

5. Discussion

Most of the sequelae of acute stroke patients are limb dyskinesia, which seriously affects the quality of life of patients. With the development of society, the medical model is changing, and the rehabilitation guidance model for stroke patients is also changing [12], and the integration of superior resources is imminent.

From our observation results, we can see that the difference of motor function scores between the control group and the treatment group before and after treatment is highly significant, which fully shows that there is a natural recovery ability of compensation and functional reorganization in the structure and function of the central nervous system after stroke. By comparison, it was found that there was no significant difference in Barthel index and FMA score between the treatment group and the control group before treatment. After treatment, the two indexes in the control group improved to a certain extent, but compared with the treatment group, the improvement degree was far less than that in the treatment group, and the difference was statistically significant (P < 0.01), which was similar to the related research results [13].

After stroke, the central nervous system has the natural recovery ability of compensatory and functional reorganization in structure and function, which is due to the disappearance of edema, absorption of hematoma, decrease of intracranial pressure and the past of "shock period" of nerve cells at the edge of some necrotic areas. At the same time, exercise can increase the thickness of cerebral cortex, increase protein content and new angiogenesis, and promote the increase of cerebral blood flow [14-15]. Promote the reorganization or compensation of the lesion Zhou Guo tissue or healthy brain cells, and give full play to the "plasticity" of the brain, so the rehabilitation treatment group can improve the motor function of patients more effectively than the control group.

The recovery of hemiplegia after stroke starts from several days after onset, and reaches the maximum after 1-3 months. After 3 months, the recovery slows down due to various secondary obstacles, so rehabilitation treatment should be intervened as soon as possible. However, Wang Xiaodong et al. [16] carried out rehabilitation treatment within one week after the onset of stroke, and found that its curative effect was obviously better than that of patients who started rehabilitation treatment one month after the onset of stroke, which may be due to the fact that this study only gave rehabilitation intervention such as placement of good limbs to patients, but did not carry out high-intensity rehabilitation training. Timely rehabilitation, which is mainly based on exercise therapy, is conducive to inducing the transmission of a large number of information from skin, deep joints and superficial receptors, and the transmission of a large number of motor impulse information from the

brain center, so it can promote the reorganization of cerebral cortex function and finally promote the restoration of motor function.

Give the patient correct posture guidance, and the correct posture will help to avoid the deformity of the patient; For passive rehabilitation, flexion and extension exercises should be performed on the affected limb joints, and massage should be performed on the patients to relieve muscle spasm of the affected limb. Patients may learn and train some motor functions spontaneously, but they are often not timely and correct, and their activities are insufficient, which is easy to produce disuse changes of motor organs, such as muscle atrophy and joint contracture. This phenomenon also shows that although the function of hemiplegic patients can be naturally improved to a certain extent, if early rehabilitation intervention, the motor function of patients can be improved faster, better and to a greater extent, and the self-care ability of patients can be improved.

6. Conclusions

Early comprehensive rehabilitation can promote the rehabilitation of motor function of patients with acute stroke. We believe that comprehensive hospitals should focus on rehabilitation of acute and subacute patients, so as to improve the function and quality of life of patients and improve the overall curative effect of hospitals.

References

- [1] Gu Dasheng, Zhang Jiamin. *Clinical study on improving comprehensive function of stroke patients with hemiplegia by tertiary rehabilitation therapy. Foot and Health Care*, vol. 26, no. 021, pp. 74-75, 2017.
- [2] Peng Juan, Yang Shibin, Xu Fangyuan, et al. *Effect of early interventional mirror therapy on functional recovery of hemiplegic limbs in patients with ischemic stroke. Chinese Journal of Physical Medicine and Rehabilitation*, vol. 41, no. 3, pp. 178-183, 2019.
- [3] Hu Qinghua. *Effect of early comprehensive rehabilitation treatment on ADL score of stroke patients with hemiplegia. Chinese and Foreign Medical Research*, vol. 07, No.339, pp. 161-162, 2017.
- [4] Molteni F, Formaggio E, Bosco A, et al. *Brain Connectivity Modulation After Exoskeleton-Assisted Gait in Chronic Hemiplegic Stroke Survivors: A Pilot Study. American Journal of Physical Medicine & Rehabilitation*, vol. 99, no. 8, pp. 1, 2020.
- [5] Jiang Dan. *Effect of early rehabilitation on limb function and activities of daily living of stroke patients with hemiplegia. Oriental Diet and Health Care*, vol. 000, no. 004, pp. 62, 2017.
- [6] Zhang Xinjie. *Half-year observation on the effect of rehabilitation treatment on the function of stroke patients with hemiplegia. Health Frontier*, vol. 026, no. 011, pp. 240, 2017.
- [7] Longhi M, Muraccini M, Berardi A, et al. *Shoulder kinematics in hemiplegic patients after stroke. Pilot study. Gait & Posture*, 2019, 74:24-25.
- [8] Cui Zhihui, Ren Huiming, Guo Xu, et al. *The effect of intramuscular sticking of trunk core muscles combined with conventional rehabilitation treatment on the recovery of lower limb function in stroke patients with hemiplegia. Chinese Journal of Physical Medicine and Rehabilitation*, vol. 042, no. 001, pp. 63-65, 2020.
- [9] Lee Z I, Yu K J, Lee D H, et al. *The Effect of Nebulized Glycopyrrolate on Posterior Drooling in Patients with Brain Injury: Two Cases of Different Brain Lesions. American Journal of Physical Medicine & Rehabilitation*, vol. 96, no. 8, pp. 1, 2017.
- [10] Chen Min, Xia Yuehong. *to explore the effect of early rehabilitation on limb function and activities of daily living of stroke patients with hemiplegia. everyone's health*, vol. 516, no. 07, pp. 16-16, 2020.
- [11] Kim C Y, Lee J S, Kim H D. *Comparison of the Effect of Lateral and Backward Walking Training on Walking Function in Patients with Poststroke Hemiplegia. American Journal of Physical Medicine & Rehabilitation*, vol. 96, no. 2, pp. 61-67, 2017.
- [12] Liu Chunlei, Liu Xia, Li Feng. *Effect of 30 min action observation training combined with rehabilitation therapy on depression scale and visual simulation score of early stroke hemiplegic patients. Chinese Primary Medicine*, vol. 25, no. 20, pp. 2669, 2018.
- [13] Zhang Xiaoyan. *Study on the intervention effect of early rehabilitation on stroke patients with hemiplegia. Medicine and Health Care*, vol. 026, no. 012, pp. 113-115, 2018.
- [14] Zhang Haiyuan, Wang Qian, Liu Chao. *Observation on the therapeutic effect of ultrasound-guided intra-articular injection combined with rehabilitation on shoulder pain after hemiplegia. Chinese Journal of Physical Medicine and Rehabilitation*, vol. 041, no. 001, pp. 53-55, 2019.
- [15] Li Yanping, Sun Haiyun, Ma Ronghui, et al. *Effect of caregiver training on the quality of life of stroke patients with hemiplegia. Electronic Journal of Clinical Medical Literature*, vol. 6, no. 26, pp.

148-150, 2019.

[16] Wang Xiaodong. *Analysis of the influence of standardized tertiary rehabilitation treatment on the comprehensive function of stroke patients with hemiplegia. Electronic Journal of Clinical Medical Literature*, vol. 7, no. 23, pp. 43-43, 2020.