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Original Article

Effect of visual training on cognitive function in stroke patients

Chang-Xiang Chen[*], *Rong-Hua Mao*, *Shu-Xing Li*, *Ya-Ning Zhao*, *Min Zhang*

College of Nursing and Rehabilitation, North China University of Science and Technology, Tangshan, China

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ABSTRACT

Objective: To observe the effect of visual training on cognitive function in stoke patients.
Methods: Eighty stroke patients with cognitive dysfunction were divided into two groups ($n = 40$ in each group). The control group received conventional rehabilitation therapies. The experimental group received visual training in addition to the conventional therapies. This training was administered for 30 min once a day, five times a week, for four weeks. All patients were screened with the Montreal Cognitive Assessment (MoCA) both before and after the four weeks of intervention.
Results: After the four-week intervention, patients in the experimental group increased their scores for attention and concentration, executive function, memory, visual skills, abstract thinking, calculation, and directional force, as well as their total standard score ($p < 0.01$). The patients in the control group also increased their scores in the executive function, visual skills and abstract thinking, as well as their total standard score ($p < 0.05$). However, the experimental group scored higher than the control group for both the individual and total standard scores ($p < 0.05$).
Conclusion: Visual training could improve cognitive function of patients with stroke.

1. Introduction

The incidence and disability rate of stroke is increasing, with a reported 75% of stroke survivors having some cognitive dysfunction [1]. The impact on memory and executive function are the most obvious [2], and these deficits can seriously affect the patient's quality of life and comprehensive rehabilitation, as well as add a huge burden to the family and society. At present, research on therapies for improving cognitive impairment after stroke in China is primarily focused on using computer-assisted cognitive training, cognitive behavioral therapy, electroacupuncture therapy, and somatosensory interactive games. The use of virtual reality technology (VR), eye movement therapy, and visual search training have mainly been adopted abroad [3–5].

* *Corresponding author.*
E-mail address: hlxccx@163.com (C.-X. Chen).

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However, many of the traditional therapies have limitations, including limited availability for the therapies and delayed feedback. Visual training, however, can be done using any computer that can link to the internet. After choosing the suitable model for training, the system can adapt to the patient's performance by increasing or decreasing the difficulty level. It also gives the patients the ability to track their training progress on their own. Previously, this kind of training has been shown to improve cognitive deficits in patients with schizophrenia [6], and patients with mild cognitive impairment [7]. However, the effect of effect of visual training on the cognitive dysfunction seen in stroke patients has not been well studied; therefore, this study will explore the possibility of using comprehensive vision training games to improve the cognitive dysfunction in stroke patients.

2. Subjects and methods

2.1. Subjects

The subjects for this study were stroke patients at the Tangshan Worker's Hospital Rehabilitation Hospital from 2014 June to 2015 January. Of the 80 stroke patients included in the study, 52 were male and 28 were female, aged 45–74 years old, with an average age of (57.74 ± 8.543) years. The stroke cases included 57 cases of cerebral infarction and 23 cases of cerebral hemorrhage; 31 cases of left hemiplegia, 36 cases of right hemiplegia, and 13 cases of bilateral paralysis; and 56 cases of simple basal ganglia lesions and the other 24 cases.

Inclusion criteria: 1) All patients had to meet the diagnostic criteria developed by the Fourth National Conference on Cerebrovascular Disease in 1995 [8], and were confirmed by either CT or MRI. 2) This event was their first episode of stroke, 3) and the stroke had to have occurred within the past three months. 4) The patients had to have a cognitive dysfunction as defined as a Montreal Cognitive Assessment (MoCA) score of <26 points for educated patients, and for patients with 12 years or less of education, <27 points. 5) All patients had to be between 45 and 74 years old, and 6) had to voluntarily join this study with informed consent.

Exclusion criteria: Patients were excluded who 1) had mental retardation, mental illness or coma; 2) severe cerebral atrophy or leukoaraiosis; 3) vision defects, hearing loss and severe aphasia; 4) serious heart, liver, renal insufficiency, respiratory failure and cancer or other serious physical diseases; 5) drugs abuse, alcohol dependence.

The 80 stroke patients were randomly divided into either the experimental or the control group, with 40 cases for each group.

2.2. Methods

2.2.1. Procedure and ethical considerations

This study was approved by the university ethics committee. All patients voluntarily participated in this study and informed consent was obtained from all subjects. The data was collected using a questionnaire survey administered by the researchers in a one-on-one meeting.

2.2.2. Instruments

The control group was treated using conventional rehabilitation therapies, including occupational therapy, physical therapy, acupuncture, balance coordination training, and gait training. The experimental group was treated with the conventional nursing therapies, combined with visual training [9].

Choice of training system: stroke patients with cognitive dysfunction eye movements and visual scanning effectiveness of intervention methods, for this research adopts the visual training laid a theoretical basis. Patients used a computer linked to the internet to log in to a system which can be used to train the brain. These programs are simple and easy to understand, and gives feedback and an objective evaluation in time. After logging in to the system, the researcher can choose the suitable model for training to ensure the safety of the patients with hemiplegia. This study used four game modes: Double Decision, Target Tracking, Hawk Eye, and Visual Sweeps. Double Decision mainly trains for attention, Target Tracking trains for executive function, Hawk Eye trains for memory ability, and Visual Sweeps trains for spatial orientation. Using all four kinds of training modes allows for the most comprehensive way to improve cognitive function in patients with stroke. In general, training occurred between 9 and 10 am, but varied based on the schedule for the other treatments the patient had scheduled that day. After logging into the program, every time only one patient to training, Follow the principle of individualization, Adopted one to one way to training. Before the new model to training, the researchers demonstrated it first, then patients to training, and researchers should be accompany in side, to ensure the training smoothly.

For the Double Decision mode, the goal is to focus the car on the center of the screen, search for "Route 66" highway signs on the screen edges, remembering the car's shape and the location of appearance of "Route 66" signs. At the conclusion of the track, the cars and "Route 66" signs are automatically covered, and two different cars appear in the center of the screen. The subject must then choose which car they had seen and the correct positions of "Route 66" highway signs.

For the Target Tracker mode, a bubble appears on the screen as the target, the bubble begins to move, and more bubbles begin to appear and move together. When all the bubbles stop moving, the subject must identify the target. If correctly identified, the next round will have two bubbles as targets, and so on as the subject progresses. Depending on the performance, the number of bubbles will increase or decrease, with up to six targets.

For the Hawk Eye mode, a group of birds in a circular arrangement appear on the screen, and one of them has a different shape or color compared to other birds. The subject remembers the location of the bird for a specified period of time, and indicate its position when the target disappears.

For the Visual Sweeps mode, a square at the center of the screen emerges in a total of four different sweep directions: vertical, horizontal, and two diagonal, and each scanning direction can occur either inward or outward. When the scan is completed, inward and outward arrows will appear on the screen, and the subject indicates which scan direction by clicking on the arrow.

Each game mode includes ten levels, with the difficulty gradually increasing in each subsequent level. As the level