

Research Progress on the Use of Music Therapy Combined with Transcranial Magnetic Stimulation to Treat Cognitive Impairment after Stroke

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Abstract: Stroke patients may develop different functional impairments, including cognitive impairment after treatment. To improve their condition, music therapy combined with transcranial magnetic stimulation therapy should be used in rehabilitation treatment to promote their cognitive and living ability, thereby improving the patient's quality of life and easing the burden on the patient's family. Therefore, it is necessary to first clarify the concept of cognitive impairment after stroke and then elaborate on music therapy and transcranial magnetic stimulation treatment. The respective roles played in rehabilitating patients with cognitive impairment after stroke and the value of their combined application are discussed for reference.

Keywords: Music therapy; Transcranial magnetic stimulation; Stroke; Cognitive impairment

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1. Introduction

Stroke is a common neurological disease with relatively high disability and mortality rates. With the support of contemporary medicine, the mortality rate of patients in the acute phase has dropped significantly. However, the disability rate is still not effectively managed. One of its sequelae is cognitive impairment, which seriously affects the patient's quality of life, and increases the burden on the patient's family. According to relevant studies, there are about 2 million new stroke patients in China every year, with an increasing rate of about 9% every year. Modern research on cerebrovascular disease emphasizes improving the therapeutic effect, prolonging the patient's life, and strengthening rehabilitation medicine intervention to optimize the patient's bodily functions^[1]. Recently, with the development of non-drug therapies, music therapy, and transcranial magnetic stimulation treatments have garnered attention due to their unique therapeutic mechanisms and safety. Music therapy can improve the patient's emotional states and cognitive functions by stimulating their auditory perception and emotions. Transcranial magnetic stimulation, a non-invasive brain stimulation technology, can promote neurological recovery by regulating the brain's neural activity. However, the specific efficacy of music

therapy combined with transcranial magnetic stimulation in patients with post-stroke cognitive impairment still needs to be explored.

2. Overview of post-stroke cognitive impairment

Cognitive impairment is one of the common complications after stroke. It includes memory loss, executive dysfunction, decreased attention, language understanding, and expression difficulties. This disorder seriously affects the patient's quality of life and limits their social participation and ability to carry out daily activities. Brain damage caused by stroke mainly involves the loss of nerve cells and the destruction of neural networks. These changes directly affect cognitive function. At the same time, patients may also experience mood disorders, psychological stress, and social isolation, all of which may further exacerbate cognitive decline.

3. The effect of music therapy combined with transcranial magnetic stimulation on patients with post-stroke cognitive impairment

For post-stroke cognitive impairment, conventional treatments include drug therapy, cognitive training, and rehabilitation training. Pharmacological treatments mainly focus on improving blood circulation to the brain and neuroprotection, but their direct effect on improving cognitive function is limited. Cognitive training and rehabilitation can help restore cognitive abilities to a certain extent. Still, these methods usually require continuous training for long periods and the effects vary depending on individual differences. In addition, these methods have limited effect in improving the patient's quality of life and social functioning. Therefore, there is a need to explore more effective treatments. Music therapy combined with transcranial magnetic stimulation is an innovative treatment method that utilizes the music's rhythm, melody, and harmony to stimulate the patient's emotions and cognition, improving their mood and enhancing memory and concentration. Transcranial magnetic stimulation, as a non-invasive brain stimulation technology, can promote the recovery of neurological function by altering the excitability of subcortical neurons. This combined treatment model aims to jointly promote the recovery and reconstruction of brain function through the psychotherapeutic effect of music therapy and the biological effect of repetitive transcranial magnetic stimulation (rTMS), thereby improving the cognitive ability of patients with post-stroke cognitive impairment ^[2].

4. Application model of music therapy in patients with post-stroke cognitive impairment

When carrying out rehabilitation treatment for stroke patients, music therapy can be regarded as physical therapy and an important part of speech therapy to promote the gradual recovery of the patient's speech and motor functions. However, recent studies have shown that music therapy can also improve cognitive function, further enhancing the application value of music therapy in the rehabilitation treatment of stroke patients. Providing music therapy to stroke patients can lead to rapid growth of hippocampal nerves, which can enhance brain plasticity. After patients hear familiar melodies and lyrics, they may hum along unconsciously and even recall certain memories. Memory facilitates extensive connections within the brain's bilateral communication network, thus optimizing the patient's cognitive function. According to relevant studies, patients with cognitive impairment after stroke were given playing music or other reading materials. After 6 months of continuous intervention, the attention and memory of patients who listen to music or other reading materials significantly improved. The patient's long-term plastic changes in sensory perception occurred in the early stages of brain

injury, thereby gradually restoring cognitive functions. The process of applying music therapy is relatively simple and has high application value in the rehabilitation process of stroke patients [3].

Music therapy can be divided into active and passive treatment. When conducting active treatment, also known as participatory treatment, melodies or songs familiar to the patient were used to garner the patient's interest. Patients were encouraged to directly participate in singing, playing, or physical activities following the songs during treatment. When performing passive therapy, also known as receptive therapy, patients were provided with prepared recordings or improvisation. Generally speaking, there were no clear requirements for the passive therapy process. The primary goal was to promote comfort and happiness among patients and to develop a pleasant and ideal environment for therapy. A combination of active and passive methods of music therapy can provide patients with alternating treatment methods. Medical staff first communicated with patients and their families to understand the patient's preferred music type and then selected their favorite music for therapy. In this study, music therapy was used to treat 40 patients with post-stroke cognitive impairment in the experimental group. The cognitive function score of patients who received music therapy improved from 19.13 ± 2.51 points to 25.29 ± 2.04 points after treatment. In contrast, only conventional treatment was used for the control group. There was no significant difference between the scores before and treatment in the control group ($P > 0.05$). After treatment, the scores improved to 21.35 ± 1.80 points but were lower than those of the experimental group ($P < 0.05$) [4].

Music therapy can be applied in the form of individual therapy or group therapy. When selecting music and active therapy, individual treatment plans should be formulated according to the patient's needs and appropriate music should be selected. Generally, music with a strong sense of rhythm should be selected. Passive therapy mainly selects music based on the patient's preferences. When using a group therapy model, the preferences and feelings of all group members need to be considered [5]. In addition, the homogeneity principle can also be used to select music, that is, according to the patient's emotional state. When the patient is emotionally excited, they are provided with bright and joyful music to guide the patient into a state of appropriate suppression through negative induction. The non-homogeneous principle can also be applied when selecting music, that is, by providing patients with music that contradicts their emotions. For example, providing patients with anxiety and depression with strong rhythms and cheerful music may improve their mood.

5. Application model of transcranial magnetic stimulation in patients with post-stroke cognitive impairment

The method of transcranial magnetic stimulation was developed in 1985. It is painless and non-invasive. Not only is it simple to operate but it is also highly safe and effective. rTMS treatment has been shown to effectively improve the patient's health. This treatment causes physiological, biochemical, and functional changes in the patient, where the related biological effects remain after completion of treatment. Recently, this treatment method has been widely used in the treatment of cerebrovascular diseases, epilepsy, and Parkinson's disease. The stimulation effect will not be attenuated during actual treatment due to passage through body tissues. As the electric field of magnetic stimulation is parallel to the skin, this procedure is painless, which can increase the patient's compliance with treatment.

rTMS treatment can promote significant changes in the levels of various neurotransmitters. For example, treatment through the prefrontal cortex can promote endogenous dopamine release, and treatment through the left dorsolateral prefrontal cortex can enhance 5-HT/color in local brain areas. The metabolism of amino acids was studied by applying positron emission tomography (PET), single photon emission computed tomography (SPECT), thermal conductivity detector (TCD), and other detection methods to study the pathophysiological

and neurophysiological effects of rTMS. Healthy subjects were given rTMS therapy for 20 minutes, with the left motor cortex being stimulated, while the contralateral cortex was not stimulated. In contrast, the oxyhemoglobin content on the stimulated side increased significantly, and it was still effective 40 minutes after the treatment. At the same time, the deoxygenated hemoglobin level also declined slightly, lasting for 15 minutes. rTMS was also applied to stroke patients, which improved a variety of functional impairments^[6]. The magnetic field stimulator used was the Korean transcranial magnetic stimulator (TAMAS). When the patient was supine, the dorsolateral cortex of the left prefrontal lobe was stimulated. The 10–20 International EEG recording system electrode placement method was used to determine the stimulation point. The treatment had a stimulation frequency of 5 Hz and an intensity of 80%–90% of the resting motor threshold. Each stimulation was performed in seconds followed by an interval of 6 seconds, 20 minutes a day, a total of 2,000 pulses, for 5 days a week. This treatment was carried out for 3 weeks. This treatment plan was conducive to improving the patient's cognitive function. In a study, 31 patients with post-stroke cognitive impairment in the experimental underwent this treatment plan. The experimental group's modified Barthel index (MBI) score improved from 41.61 ± 25.49 points to 59.81 ± 24.68 points after treatment. The MBI score of the control group that only received conventional treatment improved to 54.31 ± 22.19 , which was lower than that of the experimental group ($P < 0.05$)^[7].

6. Post-stroke cognitive impairment treated with music therapy combined with transcranial magnetic stimulation

The combination of music therapy and transcranial magnetic stimulation provides a multimodal intervention approach that improves the cognitive function of patients with post-stroke cognitive impairment. Transcranial magnetic stimulation can promote the reconstruction of damaged neural networks and functional recovery by stimulating neurons under the cerebral cortex. This dual stimulation helps accelerate the recovery process of cognitive function and can also repair the neurological damage caused by stroke to a certain extent. Emotional disorders are a common complication in post-stroke patients, which further affect the recovery of their cognitive functions^[8]. Therefore, improving the patient's emotional state through music therapy can improve the patient's quality of life and create a favorable psychological environment for the recovery of cognitive functions^[9]. According to relevant studies, 12 patients with post-stroke speech impairment were treated with music therapy combined with transcranial magnetic stimulation. Their aphasia quotient score was 23.46 ± 3.67 points and their spontaneous speech score was 4.33 ± 1.31 , while the scores of the 13 patients in the sham stimulation group were 8.41 ± 2.20 points and 1.08 ± 0.76 points, respectively, ($P < 0.05$). It was seen that the effect of music therapy combined with transcranial magnetic stimulation significantly improved the patient's aphasia. Improving the patient's speech function can improve treatment confidence and compliance, laying an important foundation for alleviating and eliminating cognitive impairment^[10].

Moreover, when applying music therapy, patients can engage in auditory experiences, participate, and interact with the song's chorus, rhythm coordination, and other activities. These highly interactive activities can promote the patient's social participation and improve their interpersonal skills. During rehabilitation, the patient's social communication skills can be improved, along with their sense of social participation and belonging. A supportive social environment through effective communication and cooperation with other patients can then be established, ultimately improving the patient's quality of life and rehabilitation outcomes.

7. Conclusion

Both music therapy and rTMS therapy play an important role in the rehabilitation treatment of stroke patients. They positively impacted the recovery of the patient's cognitive function. The combination of music therapy and rTMS therapy can jointly stimulate the patient's brain and nerve activities, thereby improving cognitive function. All in all, the patient's quality of life was improved.

Disclosure statement

The author declares no conflict of interest.

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