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A review of the mechanism and clinical application of electroacupuncture in the treatment of post-stroke dysphagia

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Abstract. Stroke is one of the major lethal diseases worldwide and is often associated with severe complications for instance dysphagia, which has a significant impact on the quality of life of patients. Dysphagia can lead to malnutrition, aspiration pneumonia, and a decline in overall health, significantly increasing the burden on patients and caregivers. Electroacupuncture, one of the common treatments for post-stroke dysphagia, effectively improves nerve function, enhances neuromuscular conduction, and restores swallowing ability through stimulation of specific acupoints. Compared with traditional rehabilitation methods, electroacupuncture can provide targeted interventions to support the recovery of motor function and sensory pathways, shorten rehabilitation time and improve rehabilitation outcomes. This article reviews the pathogenesis and risks of post-stroke dysphagia, mechanisms of action, indications and contraindications, timing of application and treatment, and efficacy and benefits. In addition, it compares the advantages of electroacupuncture with those of traditional therapies and highlights its potential to enhance therapeutic efficacy when used in conjunction with other rehabilitation tools.

Keywords: Stroke, dysphagia, electroacupuncture, neurological rehabilitation.

1. Introduction

With millions of new stroke cases worldwide each year, stroke is not only one of the major fatal diseases worldwide, but also often leads to serious long-term complications that greatly affect patients' quality of life [1]. Among them, dysphagia is one of the most common complications in stroke patients, and about dysphagia is a common occurrence for 65% of stroke patients a stroke-induced symptom known as post-stroke dysphagia (PSD). Dysphagia is usually caused due to damage caused to the central nervous system, resulting in a dysfunction of neuromuscular control that interferes with the smooth passage of food and liquids from the mouth to the stomach. This disorder not only leads to inadequate intake, which in turn leads to malnutrition and dehydration, but also significantly increases the risk of aspiration pneumonia and choking, which can be life-threatening in severe cases. In addition, prolonged dysphagia can cause significant psychological stress to patients, increasing the incidence of depression and anxiety, which in turn exacerbates the decline in quality of life [2].

Currently, a range of rehabilitative techniques, including swallowing training, neuromuscular electrical stimulation, , physiotherapy, and nutritional support, which are mainly aimed at symptomatic relief and functional recovery of patients. However, traditional rehabilitation means have limited efficacy in some patients and require long-term adherence. In recent years, electroacupuncture therapy,

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as a therapeutic tool combining traditional acupuncture and modern electrical stimulation techniques, has gradually gained attention in the treatment of post-stroke dysphagia due to its potential therapeutic effects and low side effects [3]. Nerve regeneration may be influenced by electroacupuncture therapy, muscle function recovery, and improvement of nerve-muscle conduction by stimulating specific acupuncture points in combination with electrical stimulation. It has been shown that electroacupuncture therapy may positively affected swallowing function recovery after stroke. by activating the relevant neural pathways, modulating the function of the cerebral cortex and brainstem, and improving the regulation of swallowing movements by the central nervous system [4].

Although electroacupuncture has shown some efficacy in clinical practice, basic research on its mechanism of action is still relatively limited, and the specific biological mechanisms have not been fully revealed. In addition, existing clinical studies lack a unified treatment protocol, and the criteria for evaluating the efficacy of electroacupuncture, the frequency and duration of treatment have not yet been agreed upon, resulting in poor comparability between the results of different studies. Therefore, further systematic studies and clinical trials are important for clarifying the mechanism of action of electroacupuncture, optimizing treatment protocols, and evaluating its efficacy in different patients.

2. Pathogenesis and hazards of post-stroke dysphagia

One typical post-stroke consequence is post-stroke dysphagia (PSD). It is mostly associated with damage to the central nervous system. The swallowing center is located in the cortex, subcortex, brainstem and cerebellum. Injury to these areas leads to swallowing disorders in the pharyngeal phase, which are commonly manifested by decreased compliance and inadequate opening of the upper esophageal sphincter (UES). This is often manifested in a decrease in compliance and an incomplete opening of the upper esophageal sphincter (UES), leading to pharyngeal food retention and aspiration after swallowing. Damage to the central nervous system impairs the ability of relevant muscle groups to perform normal swallowing movements, ultimately leading to dysphagia. Dysphagia not only affects the physiological function of patients, but also often accompanied by serious complications, such as malnutrition, aspiration and aspiration pneumonia. and aspiration pneumonia. These complications will further deteriorate the patient's physical condition and affect his/her quality of life. In addition, due to the persistence of dysphagia, many patients suffer from mental health problems, for instance depression and anxiety. These negative emotions will increase the burden of rehabilitation for the patients and cause heavy financial and psychological pressure on the family and society. These negative emotions can add to the burden of rehabilitation and cause heavy economic and psychological pressure on families and society. These negative emotions can add to the burden of rehabilitation and cause significant economic and psychological stress on families and society [5].

3. Mechanism of action of electroacupuncture in the treatment of post-stroke dysphagia

Electroacupuncture combines traditional acupuncture with modern electrical stimulation technology, and can significantly improve the nerve and muscle functions of patients with post-stroke dysphagia through electrical stimulation of specific acupoints. By stimulating specific acupoints, electroacupuncture can significantly improve the neurological and muscular functions of patients with post-stroke dysphagia. Electroacupuncture can significantly improve neuron and muscle function in patients with post-stroke dysphagia by activating relevant areas in the cerebral cortex and brainstem. Electroacupuncture helps to restore swallowing by activating relevant areas in the cerebral cortex and brainstem, enhancing neuronal activity, promoting neuroplastic changes in swallowing movements, and increasing cortical motor excitability. and increase the excitability of cortical movements, thus helping to restore the swallowing function [6]. Research has demonstrated that electroacupuncture at this specific point can enhance neuronal activity in the cerebral cortex and activate neurons in the parabrachial nucleus and the nucleus tractus solitarius, thereby improving swallowing function [7]. Other studies have also found that high-frequency electroacupuncture stimulation can enhance the excitability of the cerebral cortex and positively affect motor neurons in the medulla oblongata [8].

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Through this series of effects, electroacupuncture can promote nerve conduction between the brain and the swallowing muscle groups.

Electroacupuncture can also enhance the function of swallowing muscle groups by improving neuromuscular transmission [9-10]. Electrical stimulation can repair the pharyngeal nerve ring and enhance the coordination of oropharyngeal and facial muscles, improving tongue flexibility and laryngeal elevation, thereby enhancing swallowing function [11-12]. Studies have also shown that electroacupuncture stimulation of the supraglottic muscles can increase pharyngeal muscle contraction, reduce the incidence of aspiration, and effectively improve swallowing function in patients [13]. In addition, electroacupuncture can enhance nerve conduction and muscle function by promoting nerve regeneration and muscle remodeling. For instance, electroacupuncture targeting the supraglottic muscles can activate paralyzed pharyngeal muscles and increase the speed of food passage through the pharynx, thereby reducing the risk of aspiration. These mechanisms of action allow electroacupuncture to demonstrate significant rehabilitative potential in the treatment of dysphagia after stroke [14].

3.1. Indications and contraindications

Electroacupuncture is indicated for the majority of patients presenting with dysphagia after stroke, particularly those individuals with dysphagia due to CNS damage. In addition, electroacupuncture is indicated in individuals with malnutrition or risk of aspiration. Electroacupuncture is also recommended for patients who are malnourished or at risk of aspiration to reduce the occurrence of complications. However, contraindications include pregnancy, the presence of cardiac pacemakers, and severe bleeding tendencies. A thorough assessment of the patient’s health status is essential before selecting electroacupuncture to ensure both the safety and efficacy of the treatment.

3.2. Timing of application and treatment

Electroacupuncture should be intervened as early as possible post-stroke dysphagia rehabilitation to maximize its therapeutic effect. Studies have shown that early intervention promotes neuroplasticity and reduces the duration of loss of swallowing function, thereby improving patients' quality of life. In the acute and sub-acute phases, electroacupuncture can help reduce the incidence of dysphagia, while in the chronic phase, electroacupuncture can be an effective complementary tool to encourage the restoration of swallowing ability. The optimal duration and frequency of treatment varies with individual patients, but 2-3 sessions per week for a few weeks to a few months is usually recommended for optimal recovery.

3.3. Efficacy of electroacupuncture therapy

Clinical studies have shown that electroacupuncture has significant efficacy in individuals who experience dysphagia after a stroke. Through precise current and frequency stimulation, electroacupuncture can enhance the recovery of the nervous system and effectively promote the improvement of swallowing function [16]. Compared with traditional acupuncture, electroacupuncture has the characteristics of stable stimulation volume and high repeatability, which makes it have a higher operability and consistency. The swallowing ability of most patients after receiving electroacupuncture treatment has been After receiving electroacupuncture treatment, the swallowing ability of most patients was significantly improved, the incidence of aspiration was reduced, and the quality of life was also improved accordingly.

3.4. Comparison with other treatment methods

Compared with traditional acupuncture, electroacupuncture has the following advantages: firstly, the stimulation intensity and frequency of electroacupuncture can be precisely controlled. Firstly, the stimulation intensity and frequency of electroacupuncture can be precisely controlled, avoiding the unstable therapeutic effect brought about by the difference of traditional acupuncture techniques. Secondly, the therapeutic effect of electroacupuncture has Secondly, the therapeutic effect of electroacupuncture is more repeatable. In addition, electroacupuncture can be merged with modern rehabilitation methods, for instance neuromodulation technology and physiotherapy, to enhance the

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therapeutic effect. In addition, electroacupuncture can be merged with modern rehabilitation methods, such as neuromodulation technology and physical therapy, to enhance the therapeutic effect. However, electroacupuncture also has certain limitations, such as the need for specialized equipment and technicians to operate, and the cost of treatment. However, electroacupuncture also has some limitations, such as the need for specialized equipment and technicians to operate it, and the relatively high cost of treatment. In some cases, such as when the patient is unable to tolerate electrical stimulation or when there are contraindications, electroacupuncture may not be effective. In some cases, such as when the patient cannot tolerate electrical stimulation or when there are relevant contraindications, traditional acupuncture and other rehabilitation methods may be a more appropriate choice. Therefore, the advantages and disadvantages of electroacupuncture versus other therapeutic methods should be weighed on a patient-by-patient basis. Electroacupuncture should be intervened as early as possible in the treatment of dysphagia after a stroke to maximize its therapeutic effect. Early studies have demonstrated that intervention can promote neuroplasticity and reduce the duration of loss of swallowing function, thus improving the patient's quality of life. In the acute and sub-acute phases, electroacupuncture can help reduce the incidence of dysphagia, whereas in the chronic phase, electroacupuncture can be used as a treatment for dysphagia. chronic phase, electroacupuncture can be an effective complementary tool to encourage the restoration of swallowing function. The optimal duration and frequency of treatment varies with each patient; however, two to three sessions per week over a period of several weeks to a few months is typically recommended to achieve the best recovery.

4. Discussion

Several studies have confirmed the efficacy of electroacupuncture in post-stroke dysphagia. However, the mechanism of electroacupuncture However, the mechanisms of electroacupuncture remain complex and have not been fully elucidated. Although existing studies suggest that electroacupuncture can promote swallowing function by activating neural pathways and improving neuromuscular transmission Although existing studies suggest that electroacupuncture can promote the recovery of swallowing function by activating neural pathways and improving neuromuscular transmission, the specific biological mechanisms, especially in terms of neuroplasticity and muscle remodeling, are not yet understood. Although existing studies suggest that electroacupuncture can promote the recovery of swallowing function by activating neural pathways and improving neuromuscular transmission, the specific biological mechanisms, especially the detailed pathways of neuroplasticity and muscle remodeling, need to be further explored. For the clinical application of electroacupuncture therapy, the problem of standardization still exists. For the clinical application of electroacupuncture, the problem of standardization still exists. The efficacy of electroacupuncture is closely related to the frequency, intensity and duration of stimulation. closely related to the frequency, intensity and duration of stimulation, the lack of consistency in treatment protocols between different studies leads to poor comparability of results. Therefore, future efforts should focus on developing uniform treatment protocols through multicenter, large-scale randomized controlled studies to ensure treatment consistency, standardization, and reproducibility. In addition, more studies are needed to verify the long-term efficacy and safety of electroacupuncture in order to ensure the effectiveness of electroacupuncture in practice. the efficacy and safety of electroacupuncture in practical applications.

Electroacupuncture has great potential as an effective intervention in a multimodal rehabilitation strategy. In combination with other rehabilitation measures, such as swallowing training, physiotherapy and neuromodulation techniques, the combined application of electroacupuncture can be used in multiple ways to pathways to jointly promote neurological and muscular rehabilitation, thereby improving the overall therapeutic effect. This combined strategy not only optimizes the rehabilitation process, but also has the potential to shorten the rehabilitation time and reduce the patient's dependence on long-term rehabilitation. dependence on long-term rehabilitation therapy. In the future, personalized treatment will also be a key direction in electroacupuncture research. Patients vary in the severity and duration of their condition, as well as in their physiological and psychological characteristics. Therefore, a personalized electroacupuncture treatment plan can enhance adaptability to each patient’s specific

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needs, improving treatment outcomes. Individualized therapy should be dynamically adjusted based on the patient's condition, symptoms, and response to electroacupuncture to achieve the best rehabilitation results.

To further enhance the effectiveness of electroacupuncture in post-stroke dysphagia, future research should focus on several key aspects. It is essential to investigate the underlying mechanisms of electroacupuncture on the nervous system and muscle function, particularly its effects on neuroplasticity and muscle remodeling, to understand how it improves post-stroke dysphagia. Optimizing clinical study designs is crucial, including establishing standardized treatment protocols and efficacy evaluation criteria, increasing multicenter and large-scale randomized controlled studies, and strengthening long-term follow-up to verify the safety and effectiveness of electroacupuncture. Additionally, combining electroacupuncture with other rehabilitation modalities, such as swallowing training, physiotherapy, and neuromodulation techniques, could form a multimodal rehabilitation strategy, enhancing treatment outcomes, shortening recovery times, and reducing dependence on long-term rehabilitation. Finally, developing personalized treatment plans for patients at different stages and with varying degrees of dysphagia will allow for tailored treatment parameters, ensuring the best rehabilitation results.

5. Conclusion

Electroacupuncture, which combines traditional acupuncture with modern electrical stimulation techniques, has demonstrated a significant rehabilitation potential. By stimulating specific acupoints, electroacupuncture can activate relevant areas in the cerebral cortex and brainstem and improve the regulation of swallowing function the central nervous system is responsible for, thus accelerating the speed of swallowing and brainstem, improving the central nervous system's regulation of swallowing function and accelerating neurological and muscular recovery. Although studies have demonstrated the efficacy of electroacupuncture. Although the preliminary efficacy of electroacupuncture has been demonstrated, more high-quality basic and clinical studies are needed to further elucidate its mechanisms of action and optimize therapeutic protocols. Future research should also explore the synergistic effects of electroacupuncture in combination with other rehabilitation modalities. These efforts aim to provide more comprehensive and effective treatment options for patients with post-stroke dysphagia, ultimately improving their long-term prognosis and enhancing their quality of life.

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