Effects of Wushu Exercise on Cognitive and Motor Function of Patients with Mild Cerebral Apoplexy

Yong Wang

ABSTRACT

Wushu has been widely used in the rehabilitation of a variety of diseases, but its effect on patients with cerebral apoplexy has not been clearly explained. Under this background, after reducing the difficulty of Wushu actions, the study focuses on the effect of Wushu exercise on cognitive function and motor function of 71 patients with mild cerebral apoplexy by means of clinical control experiment. By comparing the results of EEG mean and variance, and performance on Montreal Cognitive Assessment Scale and Wolf Motor Function Scale between the experimental group and the control group, it's found that Wushu can promote the recovery of cognitive function and motor function of patients. However, the recovery of cognitive and motor functions of patients is not achieved by the recovery of controlling functions of nerve cell in charge of corresponding functions, but by the compensation effect among nerve cells in different regions. The conclusion of this study has important theoretical and practical significance in guiding the rehabilitation treatment of patients with cerebral apoplexy.

Key Words: Cerebral Apoplexy, Wushu, Motor Function, Cognitive Function

Introduction

Cerebral apoplexy is the loss of all or part of the function of the brain and limbs caused by cerebral vascular rupture. Statistical research shows that cerebral apoplexy is a disease with high mortality and death rate, and especially brings great impact on the middle-aged and elderly people. It is estimated that more than 2 million cases of cerebral apoplexy occur every year in China alone, and more than 65% of the patients cannot partially or completely take care of themselves. Most of them remain disabled after surgery, which brings great economic burden and mental pressure to the patients and their families. How to improve the therapeutic effect of patients with cerebral apoplexy, especially the quality of life of the survived patients, has become an important topic in the field of medical rehabilitation. Studies in modern brain science have shown that motor and neurological dysfunction of patients with cerebral apoplexy are significantly associated with neuronal necrosis in specific functional areas of the brain (Kim, 2014). For example, the patients of cerebral apoplexy with language dysfunction generally suffer from the neuronal necrosis in the language functional area, and the patients of cerebral apoplexy with hearing dysfunction generally suffer from the neuronal necrosis in the auditory functional area. According apoplexy, and through which mechanism Wushu affects the neurological function of patients, and then thus the recovery of motor function. To the findings of this study, to restore the motor function of the patients of cerebral apoplexy to some extent is to find ways to restore the corresponding function of nerve cells (Hawkins et al., 2012; Liu et al., 2016). In addition to research in the field of brain science, experts in the field of rehabilitation medicine also have an in-depth study on the...
postoperative recovery of the patients with cerebral apoplexy, and proposed exercise therapy to assist or even replace the more traditional rehabilitation therapy, traditional Chinese Wushu, running, yoga, and cycling are also popular (Kondo et al., 2013). Based on the above research, this paper focuses on how Wushu exercises affect the rehabilitation effect of patients with cerebral

**Wushu Exercise Therapy and Treatment on Patients with Cerebral Apoplexy**

Researches show that aerobic exercises, including Wushu, walking, yoga and so on, have a relatively ideal effect on the rehabilitation of patients with cerebral apoplexy. Of all aerobic exercises, experts and scholars have the most controversy opinion over Wushu (Moreno and Ribera, 2010). It's because Wushu has the largest amount of exercises and is the most difficult to move among walking, yoga and others (Ohki and Takeuchi, 2014). Patients with cerebral apoplexy often have different degrees of motor dysfunction. In severe cases, they may not be able to take care of themselves at all. In unsevere cases, there may be single dysfunction of various types (such as language and hearing) (Wittenberg et al., 2001). Therefore, many experts believe that the patients with cerebral apoplexy are not suitable for Wushu exercises. However, there are also many experts who suggest that many types of Wushu exercises are not highly athletic and that even Wushu exercises that are highly athletic can reduce the difficulty of exercises by simplifying actions (Nadeau et al., 1997). Therefore, as long as the difficulty of Wushu exercises is reduced through rational planning to a degree with easy actions, slow speed and small amplitude, it will be suitable for the rehabilitation treatment of the patients with cerebral apoplexy.

In the field of sports rehabilitation, Wushu with reduced difficulty is often called primary Wushu, which has just recently been introduced into the treatment of the patients with cerebral apoplexy, but it has been used for a long time in the field of rehabilitation therapy (Siegel, 1993). For example, cardiologists specifically recommend that patients with heart disease actively practice primary Wushu after surgery because it has the effect of relaxing mood and dredging blood vessels (Ogaya et al., 2017). Nephrologists also recommend the patients to practice primary Wushu after kidney therapy because it promotes metabolism and blood circulation and facilitates the recovery of renal function (Takeuchi et al., 2005; Meires et al., 2015). In recent years, some therapists in cerebral apoplexy rehabilitation have suggested that the patients with mild cerebral apoplexy practice primary Wushu, which not only will not bring pressure on patients, but also will promote the recovery of their motor function. This study draws lessons from the current researches on the primary Wushu in rehabilitation therapy, but in order to make the research smoothly, only takes the patients with mild cerebral apoplexy as research subjects.

**Methods**

**Experimental subjects**

All experimental subjects in this study are the patients with mild cerebral apoplexy under the treatment in Rehabilitation Medicine Department of a hospital in Chengdu, Sichuan Province. As mentioned above, in view of the fact that primary Wushu is still difficult for patients with cerebral apoplexy, the subjects need to have a certain basis of motor function. Thus, all patients with cerebral apoplexy participating in this experiment are those who suffer from mild cerebral apoplexy, and those with severe cerebral apoplexy are not within the scope of study.

<table>
<thead>
<tr>
<th>Table 1. Comparison of Two Groups</th>
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<td><strong>Age</strong></td>
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<td><strong>Stature(cm)</strong></td>
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<td><strong>Weight(kg)</strong></td>
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A total of 71 participants are selected for the study. Before the formal experiment, we conduct a statistical analysis on the basic situation of all subjects. The experimental results show that there is no significant difference in the basic situation of all subjects, which meet the requirements of the experiment. In the course of the experiment, 71 subjects are divided into two groups. One group is the experimental group, which adopts "primary Wushu exercise + routine rehabilitation therapy", and the other group is the control group, which are treated with "routine rehabilitation therapy".

**Experimental steps**

This study focuses on the effect of rehabilitation treatment of primary Wushu by means of clinical control experiment, with an experimental period of 24 weeks. Before the start of the formal experiment, the experts in rehabilitation therapy
for cerebral apoplexy and in Wushu are interviewed, and with the help of related experts, a set of primary Wushu actions suitable for the patients with mild cerebral apoplexy. Subsequently, for the clinical control experiment, the following steps is determined for training the patients of the experimental group:

Stage I: The main purpose is to be familiar with the corresponding primary Wushu actions. The patients should take standing position with both feet on the ground, step back and whirl arms on both sides, part the wild horse’s mane, step forward and backward, step side and other prescribed actions as far as possible to move the limb joints, and to reduce the amount of actions of the limbs with dysfunction. The exercise time is 30 minutes once, with 3 times a week for 6 weeks in total.

Stage II: It’s the transition stage, during which the patients should further consolidate and get familiar with the actions. In the exercise process, patients should pay attention to the continuity of actions and the essentials of the force, avoiding the damage of motor function due to the error in the force. The exercise time is 30 minutes, 3 times a week for 4 weeks in total.

Stage III: It's standard practice stage, during which the patients with cerebral apoplexy who participate in the experiment should basically master the action essentials of the primary Wushu, with a clear understanding of each action exercise, and pay attention to it in the exercise. The exercise time is 30 minutes, 3 times a week for 14 weeks in total.

Selection of observation indexes
In the course of the experiment, we collect and analyze the data of the patients with cerebral apoplexy every week. The collected data include the nerve excitability data, the cognitive function data and the motor function data of the patients. The specific data are introduced as follows.

(1) Nerve excitability data. The experiment uses the EEG test to observe the nerve excitability of the patients. Considering that EEGs are generated in regions of the brain that control different functions, the experiment collects EEGs from multiple parts of the brain and compares them with each other. The greater the mean and variance of EEGs are, the stronger the neural excitability is. The experiment collects EEGs of patients as shown in the figure below.

Figure 1. Brain Wave Tests

(2) Cognitive function data. Montreal Cognitive Assessment Scale is used to demonstrate the cognitive function of the patients. The Scale is used to test the cognitive function of the subjects from the aspects of attention, computational ability, language fluency and memory ability. The total score of the Scale is 30 points. The higher the score is, the stronger the cognitive function is.

(3) Motor function data. The Wolf Motor Function Test is used to reflect the motor function of patients. The content of the Test includes swinging and grasping functions of the upper limb and the walking function of the lower limb, and it has been widely used all over the world. The Wolf Motor Function Test consists of 20 test actions, each of which is divided into 5 levels, corresponding to 0-4 points respectively, with a maximum score of 100 points. The higher the score is, the better the motor function is.

Results and Discussion
This section will interpret the experimental results from three aspects: the nerve excitability data, the cognitive function data and the motor function data.

Nerve excitability
As shown above, the changes of nerve excitability are mainly expressed by examining the changes of mean and variance of EEGs of the patients in different experimental stages. According to the related researches of brain science and neuroscience, the nerves in charge of cognitive function and motor function are distributed in specific regions of the brain.
Figure 2. Results of the Experiment (Brain Wave Tests)

2006; Kim et al., 2007), and our EEG monitoring mainly focuses on these regions and their peripheral regions. Here, the distribution area of brain nerves in charge of cognitive function is referred to as A region, the peripheral region thereof is referred to as B region, the distribution area of brain nerves in charge of motor function is referred to as C region, and the peripheral region thereof is referred to as D region.

The above figures show the changes of mean and variance of EEGs of the four distribution areas like A, B, C and D of brain nerves of the patients in the experimental group before and after the experiment: the mean and variance of EEGs of Distribution Area A before the experiment are 1.62 and 0.37, respectively, in the experimental group; they are 1.57 and 0.41, respectively, after the experiment. Through non-parametric analysis, the mean and variance don’t change significantly before and after the experiment (P>0.05). The mean and variance of EEGs in Distribution Area B are 1.87 and 0.45 respectively before the experiment, and 2.08 and 0.67 respectively after the experiment. Through non-parametric analysis, the mean and variance change significantly before and after the experiment (P<0.05). The mean and variance of EEGs in Distribution Area C are 1.71 and 0.25 respectively before the experiment and 1.73 and 0.27 respectively after the experiment. Through non-parametric analysis, the mean and variance don’t change significantly before and after the experiment (P>0.05). The mean and variance of EEGs in Distribution Area D are 1.91 and 0.51 respectively before the experiment and are 2.12 and 0.60 respectively after the experiment. Through non-parametric analysis, the mean and variance change significantly before and after the experiment (P<0.05). The patients in the control group also show a similar trend, but the degree of change is different from that of the patients in the experimental group.

The above experimental results show that the primary Wushu exercises for a period of time do not significantly improve the nerve excitability of the areas in charge of cognitive function and motor function, but improve the nerve excitability of their peripheral areas. This result actually confirms once again the results of studies on the non-regeneration of nerve cells, that’s to say, the function of nerve cells in areas that have been damaged is essentially unrecoverable (Roth and Diaz, 1995; Eldar, 2000).
Cognitive function
The Montreal Cognitive Assessment Scale is used to demonstrate the cognitive function of the patients. As mentioned earlier, the Scale measures the patients' performance in terms of attention, computational ability, language fluency, memory ability, and the like, with a total score of 30 points.

Figure 3. Results of the Experiment (Experimental Group)

Figure 4. Results of the Experiment (Control Group)

The figures above compare the Montreal Cognitive Assessment Scale between the experimental group and the control group before and after the experiment. For the patients of the experimental group, their scores in terms of attention, computing ability, language fluency and memory ability are 2, 4.5, 4.5 and 3.5, respectively, with a total score of 14.5, and the scores after the experiment are 3.5, 6.5, 5.5 and 5.5, respectively, with a total score of 20.5. The scores of all items and the total score are significantly improved after the experiment (P<0.05). For the patients of the control group, their scores in terms of attention, computing ability, language fluency and memory ability are 1.5, 4.5, 4 and 4, respectively, with a total score of 14, and the scores after the experiment are 2.5, 5.5, 5.5 and 4.5, respectively, with a total score of 18. The scores of all items and the total score are significantly improved after the experiment (P<0.05). However, we can see that the patients in the control group are not as good as those in the experimental group in the improvement of all scores and the total score, and the differences are significant (P<0.05), which shows that the primary Wushu exercises are more effective to improve the cognitive ability of the patients compared with the traditional rehabilitation therapy.

By comparing the results of Figures 4.1 and 4.2, we can find that the excitability of nerve cells in charge of cognitive function hasn't not been improved and their function has not been recovered, but the corresponding cognitive function has been significantly improved. Combined with the conclusion that the nerve excitability of peripheral nerve cells has been increased, we can conclude that the compensatory effect of nerve cells plays a key role, that's, that other undamaged nerve cells take the place of the damaged nerve cells in charge of cognitive function.

Motor function
As mentioned above, the Wolf Motor Function Test can accurately measure the motor function of the patients’ whole body, including the swinging and grasping function of the upper limb and the walking function of the lower limb. The following table shows the comparison of scores in Wolf Motor Function Test between the two groups before and after the experiment.

Table 2. Results of the Experiment (WOLF)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Prior Treatment</th>
<th>After Treatment</th>
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<tbody>
<tr>
<td>Control Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>42.17±2.37</td>
<td>59.12±1.45</td>
</tr>
<tr>
<td>Experimental</td>
<td>59.12±1.45</td>
<td>69.87±2.89</td>
</tr>
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The above data show that the average score of the experimental group is 42.17 before the experiment and 69.87 after the experiment, with a significant statistical difference (P<0.05). The average score of the control group is 43.44 before the experiment and 59.12 after the experiment.
experiment, with a significant statistical difference (P<0.05). We further statistically analyze the scores of the patients in the control group and the experimental group after the experiment, and find that the difference between them is also significant (P<0.05). The above experimental results show that the primary Wushu exercise can more effectively restore the motor function of patients.

Figure 5. Results of the Experiment (WOLF)

By comparing the results of Figures 4.1 and 4.3, we can find that the excitability of nerve cells in charge of motor function hasn’t not been improved and their function has not been recovered, but the corresponding motor function has been significantly improved. Combined with the conclusion that the nerve excitability of peripheral nerve cells has been increased, we can also conclude that the compensatory effect of nerve cells plays a key role, that’s, that other undamaged nerve cells take the place of the damaged nerve cells in charge of motor function. The conclusions in Figure 4.2 and Figure 4.3 demonstrate each other.

Conclusions
Wushu exercise therapy has always been controversial compared to the general excise therapy, because many experts believe that Wushu is too difficult for patients with cerebral apoplexy. The study shows that the primary Wushu with reduced difficulty can be used as an effective method to promote the recovery of cognitive function and motor function of patients with mild cerebral apoplexy. The concrete research conclusions of this study are as follows:

(1) After 24 weeks of primary Wushu exercise, the EEGs in the brain regions in charge of cognitive and motor functions of patients with cerebral apoplexy don’t change significantly, suggesting that the method cannot promote the recovery of nerve cells in the specific brain regions in charge of cognitive and motor functions.

(2) After a period of exercise, there is a significant increase in the nerve excitability of the peripheral regions of patients’ brain areas in charge of cognitive and motor functions, suggesting that the primary Wushu exercises enhance the neural function of these regions.

(3) Patients’ cognitive function and motor function have been greatly improved after a period of exercise. In combination with the above conclusions (1) and (2), it can be found that the compensatory effect of nerve cells promotes the recovery of cognitive function and motor function of the patients.

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