

## Effects of Cerebral Function Rehabilitation Instrument (Cerebral Rehabilitation Instrument) on Cerebral Circulation and Cerebral Function

**Authors:** Jiao Mingde, Danfeng Xu, Li Lanying, Yu Bo, Sun Zuodong, Sun Zuodong

**Date:** 2017-03-17T00:00:00+00:00

### Abstract

[Objective] To clinically observe the effects of the brain function rehabilitation instrument (brain rehabilitation instrument) on cerebral circulation and brain function. [Methods] One hundred and eighty patients with cerebrovascular disease were divided into cerebral infarction group, cerebral arteriosclerosis group, and vertebrobasilar insufficiency group, with 60 cases in each group. According to the order of visit, each group was further divided into a medication treatment group and an instrument treatment group, with 30 cases in each. The medication treatment group received conventional drug treatment for each disease, while the instrument treatment group was treated with the Aobo Brain Rehabilitation Therapeutic Apparatus for 30 consecutive days. Transcranial Doppler ultrasound (TCD), which reflects changes in cerebral hemodynamics, and brain electrical activity mapping (BEAM), which reflects changes in brain function, were selected as observation indices. [Results] In patients with cerebral infarction, the therapeutic efficacy of the experimental group was significantly superior to that of the control group ( $P < 0.01$ ), and both TCD and BEAM showed significant differences between the two groups ( $P < 0.05$  or  $< 0.01$ ); in patients with cerebral arteriosclerosis, the therapeutic efficacy of the experimental group was superior to that of the control group ( $P < 0.05$ ), and both TCD and BEAM showed significant differences between the two groups ( $P < 0.01$  or  $< 0.05$ ); in patients with vertebrobasilar insufficiency, the therapeutic efficacy of the experimental group was significantly superior to that of the control group ( $P < 0.05$ ), and TCD and BEAM also showed highly significant differences between the two groups ( $P < 0.01$ ). [Conclusion] The application of the brain rehabilitation instrument can significantly improve cerebral hemodynamic status, increase cerebral blood flow, enhance functional brain activity, eliminate tissue edema and swelling around brain lesions, relieve cerebral vasospasm, improve blood supply and hypoxic state of brain tissue, enhance metabolism of brain tissue, promote

the formation of collateral circulation on the ipsilateral or contralateral side of the lesion, activate brain cells in an inhibitory state, and enhance the brain's comprehensive analytical ability and memory function. It can be used to treat cerebral infarction, cerebral arteriosclerosis, vertebrobasilar insufficiency, and brain function decline associated with memory impairment.

## Full Text

### Preamble

#### **Brain Function Rehabilitation Apparatus (BFRA): Effects on Cerebral Circulation and Brain Function**

Jiao Mingde<sup>1</sup>, Xu Danfeng<sup>1</sup>, Li Lanying<sup>1</sup>, Yu Bo<sup>1</sup>, Sun Zuodong<sup>2\*</sup>

<sup>1</sup>Department of Physical Diagnosis, The Second Affiliated Hospital of Harbin Medical University, Harbin 150086, China

<sup>2</sup>Harbin Aobo Medical Apparatus Co., Ltd., Harbin 150090, China

\*Corresponding author: Sun Zuodong. E-mail: szd1966512@163.com

#### **Abstract:**

**[Objective]** To clinically observe the effects of the Brain Function Rehabilitation Apparatus (BFRA) on cerebral circulation and brain function.

**[Methods]** A total of 180 patients with cerebrovascular disease were divided into three groups: cerebral infarction, cerebral arteriosclerosis, and vertebrobasilar insufficiency, with 60 cases in each group. Each group was further divided into a drug treatment group and a device treatment group (30 cases each) based on the order of admission. The drug treatment group received conventional medication according to standard protocols for each condition, while the device treatment group was treated with the Aobo Brain Function Rehabilitation Apparatus for 30 consecutive days. Transcranial Doppler (TCD), which reflects changes in cerebral hemodynamics, and Brain Electrical Activity Mapping (BEAM), which reflects changes in brain function, were used as observation indices.

**[Results]** In cerebral infarction patients, the therapeutic efficacy of the experimental group was significantly superior to that of the control group ( $P < 0.01$ ), with significant differences observed in both TCD and BEAM parameters between the two groups ( $P < 0.05$  or  $P < 0.01$ ). In cerebral arteriosclerosis patients, the experimental group showed better therapeutic outcomes than the control group ( $P < 0.05$ ), with significant differences in TCD and BEAM parameters ( $P < 0.01$  or  $P < 0.05$ ). In vertebrobasilar insufficiency patients, the experimental group also demonstrated significantly better efficacy than the control group ( $P < 0.05$ ), with highly significant differences in TCD and BEAM parameters between the groups ( $P < 0.01$ ).

**[Conclusions]** Application of BFRA can significantly improve cerebral hemodynamic status, increase cerebral blood flow, enhance functional brain activity, eliminate tissue edema and swelling around brain lesions, relieve cerebral vasospasm, improve blood supply and hypoxic conditions in brain tissue, enhance metabolic activity, promote collateral circulation formation on either the ipsilat-

eral or contralateral side of lesions, activate inhibited brain cells, and strengthen comprehensive analytical ability and memory function. The apparatus can be used to treat cerebral infarction, cerebral arteriosclerosis, vertebrobasilar insufficiency, and brain function decline caused by intensive memory training.

**Keywords:** Brain Function Rehabilitation Apparatus; DC pulse electricity; Cerebrovascular disease; Cerebral infarction; Brain cell activation

Brain function decline represents a common clinical syndrome. Conditions such as post-stroke sequelae, cerebral insufficiency, cerebral arteriosclerosis, and intensive memory training in adolescents can lead to brain function deterioration due to ischemic and hypoxic states of brain cells.

Currently, brain function rehabilitation relies primarily on pharmacological therapy, wherein drugs are administered orally or intravenously and circulate throughout the body. Since drugs cannot be concentrated specifically in the brain and their effects are short-lived, this approach is time-consuming and yields suboptimal therapeutic outcomes.

The Brain Function Rehabilitation Apparatus (BFRA) represents a comprehensive therapeutic instrument that integrates Western medicine with traditional Chinese medicine, and combines chemical therapy with physical therapy. We hereby summarize and report our clinical observations on its effects on cerebral hemodynamics and brain function.

## 1 Clinical Data

This study observed a total of 180 patients with cerebrovascular disease, divided into three groups: cerebral infarction (CAI), cerebral arteriosclerosis (CAS), and vertebrobasilar insufficiency (VBI), with 60 cases in each group. Each group was further subdivided into a control group (drug therapy) and an experimental group (BFRA therapy), with 30 cases in each subgroup. All cases were strictly selected according to the diagnostic criteria established at the 1986 National Cerebrovascular Disease Conference.

The cerebral infarction group comprised 40 males and 20 females, aged 49–68 years (mean age 59.7 years). The cerebral arteriosclerosis group included 29 males and 31 females, aged 47–66 years (mean age 53.2 years). The vertebrobasilar insufficiency group consisted of 40 males and 20 females, aged 46–68 years (mean age 55.9 years).

## 2 Research Methods

Given the high positive correlation between brain function and cerebral blood flow, and that this relationship can be reflected through changes in electrical brain activity, this study primarily selected Transcranial Doppler (TCD) to reflect cerebral hemodynamic changes and Brain Electrical Activity Mapping

(BEAM) to reflect brain function changes, supplemented by clinical manifestations.

## 2.1 Instruments

1. TC2-64B and TC-2000 TCD devices manufactured by EME Company, Germany
2. DYD-500 BEAM device manufactured by Beijing Beike Medical Instrument New Technology Company

## 2.2 Methods

1. **Control Group:** Received conventional medication according to standard treatment protocols for 30 consecutive days.
2. **Experimental Group:** Treated with BFRA once daily for 20 minutes per session, with 30 sessions constituting one treatment course.

All patients underwent TCD and BEAM examinations once before and once after treatment, and the results were compared.

## 3 Results

### 3.1 Cerebral Infarction Group

Comparisons of therapeutic efficacy, hemodynamics, and neuroelectrophysiology between the two treatment methods in cerebral infarction patients are presented in Tables 1-3 .

As shown in Tables 1-3, in cerebral infarction patients, the therapeutic efficacy of the experimental group was significantly superior to that of the control group ( $P < 0.01$ ), with significant differences observed in both TCD and BEAM parameters between the two groups ( $P < 0.05$  or  $P < 0.01$ ).

### 3.2 Cerebral Arteriosclerosis Group

Comparisons of therapeutic efficacy, hemodynamics, and neuroelectrophysiology between the two treatment methods in cerebral arteriosclerosis patients are presented in Tables 4-6 .

As shown in Tables 4-6, in cerebral arteriosclerosis patients, the therapeutic efficacy of the experimental group was superior to that of the control group ( $P < 0.05$ ), with significant differences observed in both TCD and BEAM parameters between the two groups ( $P < 0.01$  or  $P < 0.05$ ).

### 3.3 Vertebrobasilar Insufficiency Group

Comparisons of therapeutic efficacy, hemodynamics, and neuroelectrophysiology between the two treatment methods in vertebrobasilar insufficiency patients are presented in Tables 7-9 .

As shown in Tables 7-9, in vertebrobasilar insufficiency patients, the therapeutic efficacy of the experimental group was significantly superior to that of the control group ( $P < 0.05$ ), with highly significant differences observed in TCD and BEAM parameters between the two groups ( $P < 0.01$ ).

## 4 Discussion

### 4.1 Therapeutic Mechanism of BFRA for Brain Function Rehabilitation

BFRA is a comprehensive therapeutic instrument that integrates DC drug iontophoresis, low-frequency pulse electrotherapy, electroacupuncture, traditional Chinese medicine therapy, and simulated brain electrophysiological waves. It can eliminate tissue edema and swelling around brain lesions, relieve cerebral vasospasm, improve blood supply and hypoxic conditions in brain tissue, enhance metabolic activity, promote collateral circulation formation on either the ipsilateral or contralateral side of lesions, activate inhibited brain cells, mobilize the brain's potential energy, and strengthen comprehensive analytical ability and memory function.

### 4.2 Relationship Between Brain Function and Cerebral Blood Flow

Under normal physiological conditions, there exists a close relationship between various functional activities of the brain and its blood supply. Ingvar (1967) used the  $^{133}\text{Xe}$  clearance method to measure changes in regional cerebral blood flow during mental activity, finding that cortical blood flow increased by an average of 8% during psychological tasks, with certain cortical regions such as the superior Sylvian gyrus showing particularly prominent increases. Olesen (1971) used the  $^{133}\text{Xe}$  clearance method to demonstrate that when the hand performed forceful movements, regional cerebral blood flow in the contralateral cortical hand representation area increased by an average of 54%, while other non-projecting areas showed an average increase of 11%. As the intensity of activity increased, the region of increased blood flow expanded along the central sulcus. Ingvar & Risberg (1973-1975) studied changes in cerebral blood flow during mental activities such as problem-solving, memory, reading, conversation, and reasoning, which caused expansion of brain activity regions and increases in regional cerebral blood flow in several areas, with an average increase of 15% [1-4].

During enhanced sensory input, blood flow in the precentral region increased more than in the postcentral gyrus. Additionally, electrical stimulation of the contralateral thumb could cause moderate increases in regional cerebral blood

flow in the motor area, more prominently in the precentral region than in the postcentral gyrus. When stimulation intensity was increased to the level of mild pain, cerebral blood flow increased more markedly, most significantly throughout the motor and frontal regions. Therefore, cerebral hemodynamic status reflects, to a certain extent, the functional activity status of the brain.

This study demonstrates that when mean flow velocity in cerebral arteries and estimated cerebral blood flow increase, brain function improves significantly.

#### 4.3 EEG as an Objective Reflection of Functional Activity

Experimental evidence demonstrates that the relationship between brain function and cerebral blood flow can be manifested through electroencephalographic activity, which shows a high positive correlation with regional cerebral blood flow. During epileptic seizures, EEG displays epileptiform discharges while regional cerebral blood flow increases substantially. Conversely, during various comatose states, EEG shows slowing while regional cerebral blood flow decreases significantly. When CO<sub>2</sub> is inhaled, pial arteries dilate, EEG frequency accelerates, and slow waves decrease. During hyperventilation-induced constriction, slow waves in the EEG increase while fast activity decreases, with both parameters showing a high degree of correlation.

This study confirms that when cerebral blood flow increases, the slow-wave power spectrum values in brain electrical activity mapping correspondingly decrease.

## 5 Conclusion

This study demonstrates that treatment with BFRA can significantly improve cerebral hemodynamic status, increase cerebral blood flow, and enhance functional brain activity. The apparatus can be used to treat cerebral infarction, cerebral arteriosclerosis, vertebrobasilar insufficiency, and brain function decline caused by intensive memory training.

Given its significant effects on improving cerebral circulation, the apparatus should be used with caution or under medical supervision in the following conditions: severe hypertension, increased intracranial pressure, glaucoma, critically ill patients, individuals with bleeding tendencies, psychiatric disorders, and children under 10 years of age.

## References

- [1] Gu Zhengzhong. Cerebral Circulation and Clinical Practice [M]. Shanghai: Shanghai Scientific and Technical Publishers, 1983: 133-136.
- [2] Zhang Yuanchang, et al. Cerebrovascular Diseases [M]. Beijing: People's Medical Publishing House, 1984(2): 26-54.
- [3] Yao Qian, et al. Fundamentals and Clinical Practice of Cerebral Hypoxia [M]. Hefei: Anhui Science and Technology Publishing House, 1990: 6-16.

[4] Han Zhongyan, et al. Practical Cerebrovascular Disease [M]. Shanghai: Shanghai Scientific and Technical Publishers, 1994: 26-82.

## Author Contributions

Jiao Mingde, Xu Danfeng, Li Lanying, Yu Bo: Clinical trial investigators of the Brain Function Rehabilitation Apparatus (BFRA);

Sun Zuodong: Inventor of the Brain Function Rehabilitation Apparatus (BFRA).

---

### Note:

1) This article is based on a clinical report issued by the Second Affiliated Hospital of Harbin Medical University on November 10, 1995, regarding the Brain Function Rehabilitation Apparatus (Patents: CN95210432.6, CN86246672.7). The data in the paper “Effects of Aobo Brain Function Rehabilitation Apparatus on Cerebral Circulation and Brain Function” published by Jiao Mingde and Sun Zuodong in *Medical & Healthcare Apparatus* in 1998 were derived from this report. This clinical report, together with another clinical report titled “Effects of Brain Function Rehabilitation Apparatus (BFRA) on Cerebral Hemodynamics and Brain Function” issued by Harbin First Hospital on November 15, 1995, was recognized by the Heilongjiang Provincial Medical Administration and served as the clinical basis for certification and registration of the Brain Function Rehabilitation Apparatus (Medical Device Registration No.: Hei Medical Device Approval (95) No. 227014).

The Brain Function Rehabilitation Apparatus originally incorporated both transcranial electrical stimulation and drug permeation/iontophoresis functions. However, extensive clinical experiments revealed that the therapeutic effect was primarily attributable to “electrical stimulation.” Therefore, subsequent product upgrades retained only the transcranial electrical stimulation function, and the device was renamed the Brain Function Rehabilitation Therapeutic Apparatus.

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv –Machine translation. Verify with original.*