Brain Function Rehabilitation Apparatus (BFRA) effect on cerebral hemodynamics and cerebral function [1)]

Congmin Yu [1] Ying Zhao [1] Caiwa Zhang [1] Guilan Wang [2] Xiuhua Zhang [2]
Shufang Mu [2] Zuodong Sun [3*]
[1](Department of electrophysiology; Harbin First Hospital, 150000, China)
[2](Department of Neurology; the first hospital of Harbin, 150000, China)
[3] (Harbin Aobo Medical Apparatus Co.,Ltd, Harbin, 150090, China)

Abstract：

[Objective] Clinical observation of Brain Function Rehabilitation Apparatus (BFRA)effects on cerebral hemodynamics and cerebral function.

[Methods] The patients with cerebrovascular disease in 120 cases, divided into vascular dementia and vertebrobasilar insufficiency two group 60 patients in each group and control group (drug treatment) and experimental group (drug and brain health apparatus in the treatment of 30 cases each) according to their treatment of conventional medicine, experimental group at the same time the application of Weinaokang daily treatment instrument 1 times, 20 minutes each time, for 30 consecutive days. Transcranial Doppler (TCD) and brain evoked potentials (BEAM) were used to detect the indexes.

[Results] Vascular dementia group and vertebrobasilar insufficiency group in the clinical trials, experimental group Vm and ECBF compared with the control group, the rate of increase was higher than the control group, the two groups showed significant difference ($P < 0.01$); theta power value of BEAM in the experimental group were significantly lower than that of control group, there was significant difference between the two groups ($P < 0.01$). The latency of event-related potentials (P300) in vascular dementia group was better than that of the control group, and there was significant difference between the two groups ($P < 0.01$).

[Conclusions] Brain Function Rehabilitation Apparatus (BFRA) can improve cerebral circulation, increase cerebral blood flow, increase the source of energy for the brain, activation of brain cells is inhibited, thereby strengthening the functional activities of the brain. It can be used in the treatment of cerebral infarction, cerebral arteriosclerosis, vascular dementia, vertebrobasilar insufficiency, and brain dysfunction due to enhanced memory.

Keywords：Brain Function Rehabilitation Apparatus；DC pulse；Cerebral vascular disease；cerebral infarction；Activated brain cells

The human brain is the most important and the most complex organ, people's emotions，ability and cleverness, sickness and death, It all comes from the brain and is associated with the brain. Therefore, the protection of brain function and intelligence is a major hot topic in today's society. Since ancient times, people have adopted drug therapy, chemotherapy, physical therapy, acupuncture, acupoint therapy and Qigong therapy. People have promoted brain function from many directions. The BFRA is a comprehensive brain function rehabilitation brain apparatus which combines western medicine with traditional Chinese medicine and combines chemotherapy with physical therapy. In order to observe its

* Corresponding author: Zuodong Sun (E-mail: sunzuodong@pai314.com)

function, we chose the most common incidence of brain function, cerebrovascular disease, as the observation object of the curative effect of the brain Kang instrument, and summarized the following reports:

1 Clinical data

In this study, we selected two of the most common and frequent diseases of cerebrovascular diseases: vascular dementia and vertebrobasilar insufficiency, 120 cases, divided into two groups. In the vascular dementia group, there were 60 patients, including 38 cases of multiple cerebral infarction and 22 cases of subcortical arteriosclerotic encephalopathy. The patients were divided into control group (drug treatment) and experimental group (medicine plus BFRA treatment) 30 cases each. Among them there were 40 males and 20 females, aged 46~80 years, with an average age of 66.4 years. There were 60 patients with vertebrobasilar insufficiency, divided into two groups: control group (drug treatment) and experimental group (medicine plus BFRA), 30 cases each. Among them there were 32 males and 28 females, aged 33~66 years, with an average age of 47.8 years.

2 Research method

Because of the relationship between brain function and cerebral blood flow: changes in blood flow in different regions of the cerebral cortex reflect the level of functional activity in these regions. The electrical activity of the brain is a commonly used indicator of brain activity: good correlation between brain electrical activity and regional cerebral blood flow. This study mainly used transcranial Doppler ultrasound to reflect changes in cerebral hemodynamics (TCD) EEG and reflect the brain functional changes (BEAM) and cognitive function event related potentials, to observe the curative effect of BFRA.

2.1 Instrument

The instrument used was the TC - 2000S type TCD instrument produced by Germany EME company, the main test items was the average blood flow velocity of middle cerebral artery (Vm) and the estimation of blood flow (ECBF), the average blood flow velocity detection and estimation of basilar artery (Vm) blood flow (ECBF).

The instrument used was SEEG type 16 lead color electroencephalogram (EEG) , evoked potential / EEG mapping instrument produced by Dandy Denmark. The main test items were the latency of event-related potential P300 and the power spectrum value of eeg.

2.2 Method

Control group： According to the routine treatment of each treatment, continuous treatment for 30 days.

Experience group： The BFRA was used 1 times a day for 20 minutes, 30 times for 1 courses. according to their respective treatment, routine medication at the same time.

All cases underwent TCD and BEAM examinations before and after treatment, while the vascular dementia group underwent P300 examination.

3 Results and analysis

3.1 Vascular dementia group

The observation indexes of vascular dementia group two therapy: the average blood flow velocity of middle cerebral artery and basilar artery blood flow and the estimation of ECBF, EEG theta frequency power spectrum value of the topographic map, the latency and the event-related potential P300, the detection results are shown in Table 1 to 4.

Table 1 Comparison of MCA mean flow velocity (Vm) of two therapies for estimation of cerebral blood flow (ECBF)

	Total number of cases	Before treatment		After treatment		Increase rate		P	
		Vm	ECBF	Vm	ECBF	Vm	ECBF	Vm	ECBF
Control group	30	36.4±11.9	252.5±72.5	45.8±11.3	305.2±74.9	25	20.8	< 0.05	< 0.05
Experience group	30	39.9±11.2	282.3±65.8	54.9±11.8	343.4±76.2	37.6	21.4	< 0.01	< 0.01
Increase rate				19.8	12.3				
P		＞0.05	＞0.05	＜0.01	＜0.05				

Table 2 Comparison of MCA mean flow velocity (Vm) of two therapies for estimation of cerebral blood flow (ECBF)

	Total number of cases	Before treatment		After treatment		Increase rate		P	
		Vm	ECBF	Vm	ECBF	Vm	ECBF	Vm	ECBF
Control group	30	33.4±9.9	267.2±86.6	35.0±9.0	271.1±95.2	4.8	1.4	> 0.05	> 0.05
Experience group	30	30.3±9.9	261.3±84.8	41.7±9.9	352.2±89.7	37	34	< 0.01	< 0.01
Increase rate				35	29.9				
P		＞0.05	＞0.05	＜0.01	＜0.01				

Table 3 Comparison of event related potential (P300) latency between the two treatments

	Total number of cases	Before treatment	After treatment	Reduction rate	P
Control group	30	368.5±47.2	363.3±43.5	1.4	＞0.05
Experience group	30	342.5±35.9	329.7±37.1	3.7	＜0.05
Reduction rate			9.2		
P		＜0.05	＜0.01		

Table 4 Comparison of two kinds of treatment BEAM rate value p

	Total number of cases	Before treatment	After treatment	Reduction rate	P
Control group	30	77.6±37.2	72.1±31.9	7.0	＞0.05
Experience group	30	59.3±16.4	48.1±12.2	18.9	＜0.01
Reduction rate			49		
P		＜0.01	＜0.01		

From table 1 and 2, in patients with vascular dementia, the Vm and ECBF in the experimental group compared with the control group, the rate of increase was higher than that of the control group, and there was a significant difference between the two groups ($P < 0.01$).

From table 3, the latency of event-related potential P300 in the experimental group was significantly different from that in the control group ($P < 0.01$), and the experimental group was better than that of the control group.

As shown in Table 4, the θ power value of BEAM was better than that of the control group, and there was a significant difference between the two groups ($P < 0.01$).

3.2 Vertebrobasilar insufficiency group

The observation index of the two therapies in the vertebrobasilar insufficiency group was the mean blood flow velocity and estimated blood flow of the double vertebral artery (VA) and the basilar artery (BA), at the same time, the power spectrum of θ frequency of BEAM is observed, the results are shown in table 5~7.

From table 5 and 6, In patients with vertebrobasilar insufficiency, the increase rate of Vm and ECBF in the experimental group was significantly higher than that in the control group, and there was a significant difference between the two groups ($P < 0.01$).

Table 5 Comparison of VA average flow velocity (Vm)，estimation of cerebral blood flow （ECBF）of the two therapies

	Total number of cases	Before treatment		After treatment		Increase rate		P	
		Vm	ECBF	Vm	ECBF	Vm	ECBF	Vm	ECBF
Control group	30	22.1±4.6	102.5±31.1	28.7±5.8	129.0±35.9	29	26	＜0.01	＜0.01
Experience group	30	21.3±4.7	100.3±36.1	34.4±6.3	159.4±36.2	61	59	＜0.01	＜0.01
Increase rate				19.8	23.5				
P		＞0.05	＞0.05	＜0.01	＜0.01				

Table 6 Comparison of BA average flow velocity (Vm)，estimation of cerebral blood flow （ECBF）of the two therapies

	Total number of cases	Before treatment		After treatment		Increase rate		P	
		Vm	ECBF	Vm	ECBF	Vm	ECBF	Vm	ECBF
Control group	30	27.4±8.0	250.6±77.1	30.1±6.2	259.3±60.4	9.8	3.4	＞0.05	＞0.05
Experience group	30	29.4±4.7	266.0±39.7	36.2±9.9	317.7±84.1	23	19	＜0.01	＜0.01
Increase rate				20	23				
P		＞0.05	＞0.05	＜0.01	＜0.01				

Table 7 Comparison of BEAM P value power of two therapies (%)

	Total number of cases	Before treatment	After treatment	Reduction rate	P
Control group	30	45.2±3.2	42.4±2.8	6.2	＜0.05
Experience group	30	45.3±3.6	38.7±4.6	14.6	＜0.01
Reduction rate			8.7		
P		＞0.05	＜0.01		

From table 7, the power value of θ in the experimental group was significantly lower than that in the control group, and there was a significant difference in theta power value between the two groups ($P < 0.01$).

4 Discuss

4.1 Basic treatment of rehabilitation brain function of BFRA

The BFRA is a comprehensive therapeutic apparatus which integrates the direct current medicine ion introduction therapy, the low frequency pulse electrotherapy, and the simulation brain electricity physiological wave in an organic whole. It can enhance the excitability of the nerve through acupoint stimulation, thereby improving the vasomotor function of the blood vessels, increasing the blood supply of the brain, thereby relieving the hypoxic state of the brain, promoting the metabolism of sugar, and increasing the source of energy. It activates brain cells in the inhibitory state, promotes the compensation

of brain function, mobilizes potential energy in the brain, and strengthens the brain's ability to analyze synthetically.

4.2 The relationship between brain function and cerebral blood flow[1-4]

The brain is a complex complex that is the most active organ of human metabolism. The brain has a high level of oxygen demand, and the adult oxygen consumption accounts for 50% of the total oxygen consumption. The brain also has a high demand for sugar, the amount of glucose required by the brain accounts for 17% of the total glucose consumption. The brain needs more blood, the brain weight is only 2 to 3% of the body weight, but the blood demand occupies 15 to 20% of the total cardiac output, in normal adults, the total cerebral blood flow is about 250 ml per minute, so normal brain function is dependent on adequate blood supply.

The relationship between brain function and cerebral blood flow: changes in blood flow in different regions of the cerebral cortex reflect the level of functional activity in these regions. The blood flow in the anterior part of the cortex was higher than that in the middle and posterior part when the patients were quiet, sober and closed eyes, The average brain supply of 100 grams of brain tissue was 50~54 mg per minute, with the forebrain more than 20 to 30% of the mean, This apparent difference in blood supply suggests that, even in quiet States, the activity level of the forebrain is higher than that of the posterior brain, which is about 50% higher, This is called "Frontal lobe excess". "Frontal lobe excess" is based on such a physiological and mental feature: quiet consciousness, conscious brain, every moment is the simulation of behavior, the frontal lobe is responsible for the design of this behavior. For example, when people look at an object with open eyes, it is located in the visual cortex of the frontal lobe and occipital lobe, and the blood flow increases by about 20%, Also, answering questions, conversations, reading aloud, memory and reasoning will cause simultaneous changes in blood flow in several brain regions. In random motion, such as forced movement of his hand, then the blood flow in the contralateral cortex before the central back representative area increased significantly, up to 54%, while other non projective area blood flow volume increased by only 11%. Therefore, the state of cerebral hemodynamics reflects the activity of brain to some extent.

The study also demonstrated that the use of BFRA in the experimental group can promote the average flow velocity of the basal cerebral artery and increase the estimated blood flow, while significantly changing the brain function.

4.3 Brain electrical activity is an objective index of brain function[1-4]

Good correlation between brain electrical activity and regional cerebral blood flow. Such as in the lateral geniculate nucleus, there is a close correlation between the regional cerebral blood flow and neural activity and flash frequency. Electrical stimulation of the midbrain tegmental area, reticular formation, and hippocampus increased local blood flow in the central diaphragm area at the same time, θ rhythm appears in the hippocampus. On the side of electrical stimulation, the hippocampus first appeared epileptiform discharges, At the same time, the blood flow in the diaphragm increased exponentially compared with the blood flow during the quiet period.

During epileptic seizure, the activity of spike discharges in brain electrical activity, and the local cerebral blood flow and oxygen metabolism rate increase obviously. Therefore, there is a close correlation between the frequency of brain wave activity and regional cerebral blood flow.

The cognitive process of the human brain is a complex and advanced mental process involving perception, concept, attention, memory, judgment, reasoning, imagination, thinking and language, It is a process of information processing for a certain purpose and in a certain mental structure. It is the direction and concentration of psychological activities to certain objects, and plays an important role in the further

selection of perceptual information. Hill yard believes that P300 represents the response set, i.e., the subsequent stages of perceptual information processing, reflecting the selective perception of target stimuli through the fixation channel with a proper cognitive response mechanism. The origin of P300, foreign studies suggest that the hippocampus may be derived from limbic system, prefrontal cortex or thalamus subcortical center.

The present study also demonstrated that the P300 latency in the experimental group was significantly changed compared with the control group due to the increase of blood flow in these areas by BFRA.

5 Epilogue

This study shows that: the application of the BFRA in the treatment of certain cerebrovascular disease can significantly improve the cerebral hemodynamics, increase cerebral blood flow, Increase brain energy source and activate brain cell activity, strengthen the functional activities of the brain, can be used for the treatment of cerebral infarction, cerebral arteriosclerosis, vertebrobasilar insufficiency as well as strengthening induced brain memory function.

In addition, because this instrument can obviously improve the cerebral circulation, and because this instrument is through the point of the low-frequency low-frequency pulse, the brain cells necessary nutrients from the point of direct penetration, so for the following diseases can not be used or used under the guidance of a doctor: intracranial hypertension, severe hypertension, glaucoma, critically ill patients, bleeding tendency, mental illness, children under the age of 10.

Main references:

1. Zhang Yuanchang, et al. Cerebrovascular diseases [M]. Beijing: People's Medical Publishing House, 1984 (2): 26-54.

2. Han Zhongyan, et al. Practical cerebrovascular diseases [M]. Anhui science and Technology Press, 1990:6-16.

3. Zhao Zongyan et al. The study of ERPs in vascular dementia [J]. Journal of stroke and neurological diseases, 1990, 4 (7): 196.

4. Luo Yuejia. The event related potential P300 in the composition of [J]. physical medicine and rehabilitation, 1990, 3: 101.

Author contribution:

Congmin Yu: Brain Rehabilitation Instrument (BFRA) clinical trials; Clinical report " The effection of Brain Rehabilitation Instrument (BRI) in the treatment of cerebral circulation and the function " writer.
Ying Zhao, Caiwa Zhang, Guilan Wang, Xiuhua Zhang, Shufang Mou: Brain Rehabilitation Instrument (BFRA) clinical trials;
Zuodong Sun: Brain Rehabilitation Instrument clinical trial program design participants, Inventor of Brain Function Rehabilitation Apparatus (BFRA).

1）Brain Rehabilitation Instrument（ZL95210432.6 、96246672.7） commissioned a total of two clinical company for clinical trials. This is a clinical report issued by The First Hospital of Harbin in November 15, 1995 (the original copy can be found in Aobo medical website), This clinical report was approved by Heilongjiang medical administration, at the same time, the clinical report" The effection of Brain Rehabilitation Instrument (BRI) in the treatment of cerebral circulation and the function " (the original copy can be found in Aobo medical website)issued by the Second Affiliated Hospital of Harbin Medical University was also approved by Heilongjiang medical administration，They are the clinical basis for the

certification of Brain Rehabilitation Instrument registration, Medical device registration number: HeiYiXieZhunZi(95)No.227014.

In addition to transcranial electrical stimulation, Brain Rehabilitation Instrument has drug penetration and drug iontophoresis, later, a large number of clinical trials found that the real treatment was "electrical stimulation." therefore, in the product upgrading, only the transcranial electrical stimulation was reserved.The name of the Brain Rehabilitation Instrument has undergone many changes, respectively named Aobo Brain Rehabilitation Instrument, Aobo Cerebral Rehabilitation Medical Apparatus, until now the tDCS Brain Function Rehabilitation Instrument.