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Original article

Effects of Scrambling trumpet Creeper flavone on transient cerebral ischemia model (TIA) in rats

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ABSTRACT

To investigate the effects of Scrambling Trumpet Creeper flavone on neurological function score, brain tissue lesion and related biochemical indexes in rat TIA model. Methods: TIA model was induced by tail vein injection of t-butanol (t-BHP). The rats in each administration group were given large, medium and low dose of Scrambling Trumpet Creeper flavone 0.1% CMC suspension, nimodipine and Yangxueqingnao particles group 0.1% CMC suspension, model group and blank group fed the same volume 0.1% CMC. Once a day, continuous administration of 7d. On the 3rd and 6th day after administration, t-BHP was injected into the tail vein, and then placed in a sealed 1 L jar. After 10 min of hypoxia, the neurological function score (NDS) was performed. After the first 2 days of TIA administration, the hem rheology was measured immediately after 1 h of administration, and blood rheology was measured immediately after the administration of blood, blood clotting, hematocrit, hematocrit and whole blood viscosity. After HE is staining to observe the pathological changes of hippocampus and cortex in the left-brain tissue. (LDH) and adenosine triphosphate (ATP) were measured. The right brain tissue of the cerebral cortex was observed. The expression of lactate (LD), lactate dehydrogenase (LDH) Fibroblast growth factor (FGF) and insulin growth factor (IGF) were detected by immunohistochemistry.

Results: Compared with the blank group, the coagulation time of the model rats was significantly shortened. The red blood cell deformation index was significantly decreased. Erythrocyte sedimentation rate, hematocrit, plasma viscosity, whole blood viscosity, erythrocyte rigidity index and blood sedimentation equation K value were significantly increased; LD content increased significantly, and LDH, ATP enzyme activity decreased significantly. The positive expression of FGF and IGF in the cortical area had a trend of increasing.

Conclusion: The Scrambling Trumpet Creeper flavone significantly improved the indexes of whole blood rheology; the energy metabolism of cerebral ischemia was increased, and the positive expression of neurotrophic factor in cortex was significantly increased.

1. Introduction

TIA occurs several hours or days before the onset of stroke. Signs before the onset including signs of sudden speech loss, blurred speech, physical paralysis, limb weakness, recurrent episodes, etc (Chen, 2016). TIA is a precursor of cerebral infarction (Jia et al., 2015). Early diagnosis and treatment of TIA is important to prevent ischemic stroke. Current clinical use drugs and other chemical drugs to protect cell function and structural, but the mechanism of action is single, and Combination of drugs affected by many factors (Zhang, 2016; Muhammad et al., 2017). Traditional Chinese medicine treatment of TIA has a long history. Enhance blood circulation, heat detoxification in the prevention and treatment of cerebral ischemia is an important rule (Wang et al., 2017; Sarfaz et al., 2017). Modern studies have shown that Campsis grandiflora can enhance blood circulation (Yang and Zhu, 2014; El-Meligy et al., 2017), anti-inflammatory and other pharmacological effects. There is no report on the Scrambling

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Trumpet Creeper flavone in the treatment of TIA. In this paper, we observed the effects of Scrambling Trumpet Creeper flavone on the neurological function score and brain histopathological changes of TIA rats, as well as the changes of blood rheology and the energy metabolism, and discussed the protective effect on the brain. The clinical application of the Scrambling Trumpet Creeper Flavone Prevention and treatment of transient ischemic attack to provide experimental basis.

2. Experimental material

2.1. Drugs and reagents

Scrambling trumpet Creeper flavone were supplied by the Analytical Chemistry Laboratory of Henan College of Traditional Chinese Medicine with a content of 66%, batch number 20101016; Nimodipine, Shandong Xinhua Pharmaceutical Company Limited, batch number 1107091; *tert*-butyl hydroperoxide (t-BHP), China Pharmaceutical Group Chemical Reagent Company Limited, batch number T20110303; CMC (sodium carboxymethyl cellulose), Tianjin Fu Chen Chemical Reagent Factory, batch number 20090826; Yangxue Qingnao Granule, Tianjin Tianshi Li Pharmaceutical Co., Ltd., batch number 110725; LD assay kit, Nanjing Bioengineering Research Institute, batch number 20111107; ATPase assay kit, Nanjing Institute of Biotechnology, batch number 20111206; Coomassie Brilliant Blue Protein Assay Kit, Nanjing Institute of Bioengineering, batch number 20111202.

2.2. Animals

Wistar rats, male, clean grade, 260–280 g, 105, by the Hebei Experimental Animal Center, Certificate No. 1110122. Laboratory certificate number: SYXK (Yu) 2010-001. Feeding environment is 22 ± 2 °C, 55 ± 5% relative humidity, 12 h light/dark cycle. Free drinking water.

2.3. Laboratory apparatus

UV-2000 UV Visible Spectrophotometer, Unocal (Shanghai) Instrument Co., Ltd., LBY-N6K automatic hemorheological, Beijing Puli Health Instrument Co., Ltd.

3. Experimental methods

3.1. Administration and modeling (Seema et al., 2016)

105 waster rats weighing 280–300 g were randomly divided into 7 groups: blank group, model group, positive control group (Yangxueqingnao particles group and nimodipine group), large, medium and small dose of Scrambling Trumpet Creeper flavone group, each group of 15. In addition to the blank group, the other six groups were rat TIA model, and 6 model groups were fed large, medium and small doses of Scrambling trumpet Creeper flavone suspension (200 $mg{\cdot}kg^{-1}$, 100 $mg{\cdot}kg^{-1}$, 50 $mg{\cdot}kg^{-1}$, using 0.1% CMC to make a concentration of 20 $mg{\cdot}ml^{-1}$, 10 $mg{\cdot}ml^{-1}$, 5 $mg{\cdot}ml^{-1}$, 1 ml/100 g), a Yangxueqingnao particles suspension (1000 $mg{\cdot}kg^{-1}$, using 0.1% CMC to make a concentration of 2 $mg{\cdot}ml^{-1}$, 1 ml/100 g), nimodipine (20 $mg{\cdot}kg^{-1}$, using 0.1% CMC to make a concentration of 2 $mg{\cdot}ml^{-1}$, 1 ml/100 g). Model group and blank group were fed with the same volume of 0.1% CMC.

Modeling methods: When the rats were first induced, the tail vein injection concentration of 0.11 $mol{\cdot}L^{-1}$ *tert*-butyl hydroperoxide 5.2 $ml{\cdot}kg^{-1}$, after 10 min, placed in 1 L wide mouth bottle, the mouth of bottle was sealed with vaseline and the rats were anoxic for 10 min. Then taking out the rats, proceeding the behavioral scores and using a stopwatch to measure the attack latencies of the rats. When the rats were second induced, injected with 0.154 $mol{\cdot}L^{-1}$ t-butylperoxide 5.2 $ml{\cdot}kg^{-1}$ from the tail vein, after 10 min, then placed in 1 L wide-mouth jar to be sealed, and the rats were anoxic for 10 min. Then taking out the rats, proceeding the behavioral scores and using a stopwatch to measure the attack latencies, during 1 h the number and cumulative time of attack. Each wide mouth bottle was equipped with 25 g sodium lime and sodium lime was wrapped with gauze to avoid direct contact with the rats. Sodium lime can absorb CO_2 from rats. In the experiment, each rat used new sodium lime, and was to ensure adequate, no recycling. TIA induction was performed on the 3rd and 6th day after rats were continuous intragastrical administered for 1 h. During the experiment, the animals condition was observed at any time and the dead animals were removed and the mortality rate was calculated.

Detection of indicators: the second time in the second day after TIA administration of 1 h, immediately after the eye blood, measured blood clotting time. Heparin anticoagulation, used to measure the whole blood viscosity, hematocrit, erythrocyte sedimentation rate, plasma viscosity and other blood rheology indicators.

The brain was separated in the ice tray. The left side was quickly fixed in 10% formalin solution for HE is staining and immunohistochemistry. 10% of the right brain homogenate, used to determine the LD content, LDH, ATP enzyme content.

3.2. Statistical analysis

The data were analyzed by SPSS 17.0 for windows statistical package. The data were analyzed by means of variance analysis, and the mean ± standard deviation (± s) was used. The rank data were analyzed by rank sum test.

4. Results

4.1. On NDS in TIA rats

Compared with the sham-operated group, the scores of the model group, the number of attacks, the cumulative time and the onset latency of the model group were significantly shortened ($P < 0.01$). It indicated that the TIA model was successful. Compared with the model group, ($P < 0.05$). The first episode latency was significantly prolonged. The first episode and seizure cumulative time decreased ($P < 0.01$); the number of the first episode and the cumulative time of seizure in the middle and low dose group were significantly lower than those in the control group ($P < 0.01$). The time of the second episode of the large and middle dose groups was significantly decreased ($P < 0.01$); the second score of the large, middle and small dose groups decreased significantly, the latent period of the attack was prolonged and the frequency of seizures decreased ($P < 0.01$). The cumulative time of the second episode in low dose group was significantly decreased ($P < 0.05$). The death rate of the model rats in each administration group decreased to different degrees, and the effect of high dose was the most obvious.

4.2. On the TIA model of rat brain tissue changes in the rate of nerve cells

The neurons in cerebral cortex and hippocampus of rats in sham operation group were normal. The nerve cells in cerebral cortex of rats in model group showed severe edema with eosinophilic pathological changes, and the neurons in hippocampus area showed atrophy obviously. The brain of nimodipine group Most of the

cortical neurons were normal and few were edematous with eosinophilic changes. Several cells in the hippocampus showed eosinophilic changes. In the high-dose group, the number of neurons in the cerebral cortex was decreased and the number of cells in the hippocampus was decreased; In the middle dose group, the cerebral cortical neurons of the middle dose group were normal, some of the cells were eosinophilic, the hippocampal neurons decreased obviously and all the cells were eosinophilic. The small number of normal cortical neurons were Eosinophilic change, hippocampal neurons were significantly reduced but basically returned to normal.

4.3. Effect on hemorheology of TIA model rats

Compared with the blank group, the high cut, medium cut and low-cut value of the whole blood viscosity in the model group all significantly increased ($P < 0.01$), which indicated that the modeling of rats' TIA model was successful. Compared with the model group, nimodipine group, Yangxueqingnao particles group, large, medium and small dose groups all can significantly reduce the high cut, medium cut and low-cut value of the whole blood viscosity ($P < 0.01$).

Compared with the blank group, the plasma viscosity, hematocrit, blood sedimentation was significantly increased ($P < 0.01$), and clotting time was significantly lower ($P < 0.01$). Indicating that the modeling of rats' TIA model is successful. Compared with the model group, the plasma viscosity, hematocrit and blood sedimentation of each administration group were significantly decreased ($P < 0.01$), and clotting time of nimodipine group, Yangxueqingnao particles group and high dose group decreased significantly ($P < 0.01$), and clotting time of middle-dose and low-dose group decreased. ($P < 0.05$).

Compared with the blank group, whole blood reduced viscosity was all significantly increased ($P < 0.01$), and indicating that the modeling of rats' TIA model is successful. Compared with the model group, the low cut value of whole blood reduced viscosity of the nimodipine group, Yangxueqingnao particles group, high dose group model rats significantly reduced ($P < 0.01$), the low cut value of whole blood reduced viscosity of middle and low dose group model rats significantly reduced ($P < 0.05$). The medium cut value of whole blood reduced viscosity of the nimodipine group and high dose group was significantly decreased ($P < 0.05$). The high cut value of whole blood reduced viscosity of middle-dose group was significantly decreased ($P < 0.01$).

Compared with the blank group, the erythrocyte rigidity index, K value and erythrocyte deformation index were significantly decreased ($P < 0.01$), indicating that the modeling of TIA model of rats was successful. The erythrocyte rigidity index in the nimodipine group, Yangxueqingnao granule group and the low and high dose groups were significantly decreased ($P < 0.05$). Each dose group all can decrease blood sedimentation equation K value ($P < 0.01$). The erythrocyte deformation index of the nimodipine group and high dose group was significantly increased ($P < 0.01$). The erythrocyte deformation index of Yangxueqingnao particles group and the medium and low dose groups significantly increased ($P < 0.05$). The effect of large dose group was the strongest.

4.4. Effect on ATPase activity in cerebral homogenate of TIA model rats

Compared with the blank group, the levels of Na^+-K^+-ATPase, Mg^{2+}-ATPase and Ca^{2+}-ATPase in rats cerebral tissue of the model group were significantly decreased ($P < 0.01$), indicating that the TIA model was successfully replicated. Compared with model group, each administration group all could significantly increase the levels of Na^+-K^+-ATPase, Mg^{2+}-ATPase and Ca^{2+}-ATPase in cerebral homogenate ($P < 0.01$). Among them, the high-dose Scrambling Trumpet Creeper flavone had the strongest effect.

4.5. Effect on LD and LDH levels in cerebral homogenate of TIA model rats

Compared with the blank group, LD content in rats brain tissue of the model group increased significantly and the LDH enzyme level decreased significantly ($P < 0.01$), indicating that the TIA model was successfully replicated. Compared with model group, LD content in brain homogenate of nimodipine group, Yangxueqingnao particles group and large and middle dose group were significantly decreased, and LDH level was significantly increased ($P < 0.01$). LD content in brain homogenate of low dose group was significantly decreased ($P < 0.01$), and LDH level was significantly increased ($P < 0.05$).

4.6. Effect on the positive expression of FGF and IGF in cerebral cortex of TIA model rats

From the above chart and table can be seen, FGF and IGF in the cerebral cortex of blank group were mainly weakly positive expression; FGF and IGF in the cerebral cortex of the model group were mainly weakely positive expression; FGF and IGF in the cerebral cortex of the nimodipine group were mainly strongly positive expression; FGF and IGF in the cerebral cortex of the Yangxueqingnao particles group were mainly positive expression; FGF and IGF in the cerebral cortex of the large dose group were mainly strongly positive expression; FGF and IGF in the cerebral cortex of the middle dose group were mainly positive expression; FGF and IGF in the cerebral cortex of the law dose group were mainly positive expression.

Compared with the blank group, the positive expression of FGF and IGF in the cerebral cortex of the model group had a increasing trend. Compared with the model group, except the low dose group, the positive expression of FGF in the cerebral cortex of the other administration groups all significantly increased ($P < 0.01$), and the positive expression of FGF in the cerebral cortex of the high dose group, the nimodipine group, and Yangxueqingnao particles group all significantly increased ($P < 0.01$). The positive expression of FGF in the cortex of the low dose group significantly increased ($P < 0.05$), and the positive expression of IGF in the cortex of the middle and low dose groups significantly increased ($P < 0.01$). Indicating that the Scrambling trumpet Creeper flavone have the effect of promoting the positive expression of FGF and IGF (see Figs. 1 and 2).

In summary, the Scrambling trumpet Creeper flavone had a good intervention effect on rat TIA model, which significantly reduced the behavioral scores of model rats, significantly improved the indexes of hemorheology in model rats, The expression of ATPase and LDH in the hippocampus and cortical region were significantly decreased, and the pathological changes of the brain tissue were significantly improved (see Tables 1–10).

5. Discussion

Brain tissue occured a series of pathophysiological changes during cerebral ischemia. Studies have shown that cerebral blood flow disruption and reperfusion injury are a rapid cascade reaction, which includes many links, such as energy barrier, inflammatory response, excitatory amino acid release increased, intracellular calcium instability, free radical generation, apoptosis gene activation and so on. These links are causal, overlapping, and interconnected, forming a vicious circle leading and causing apoptosis or necrosis at last.

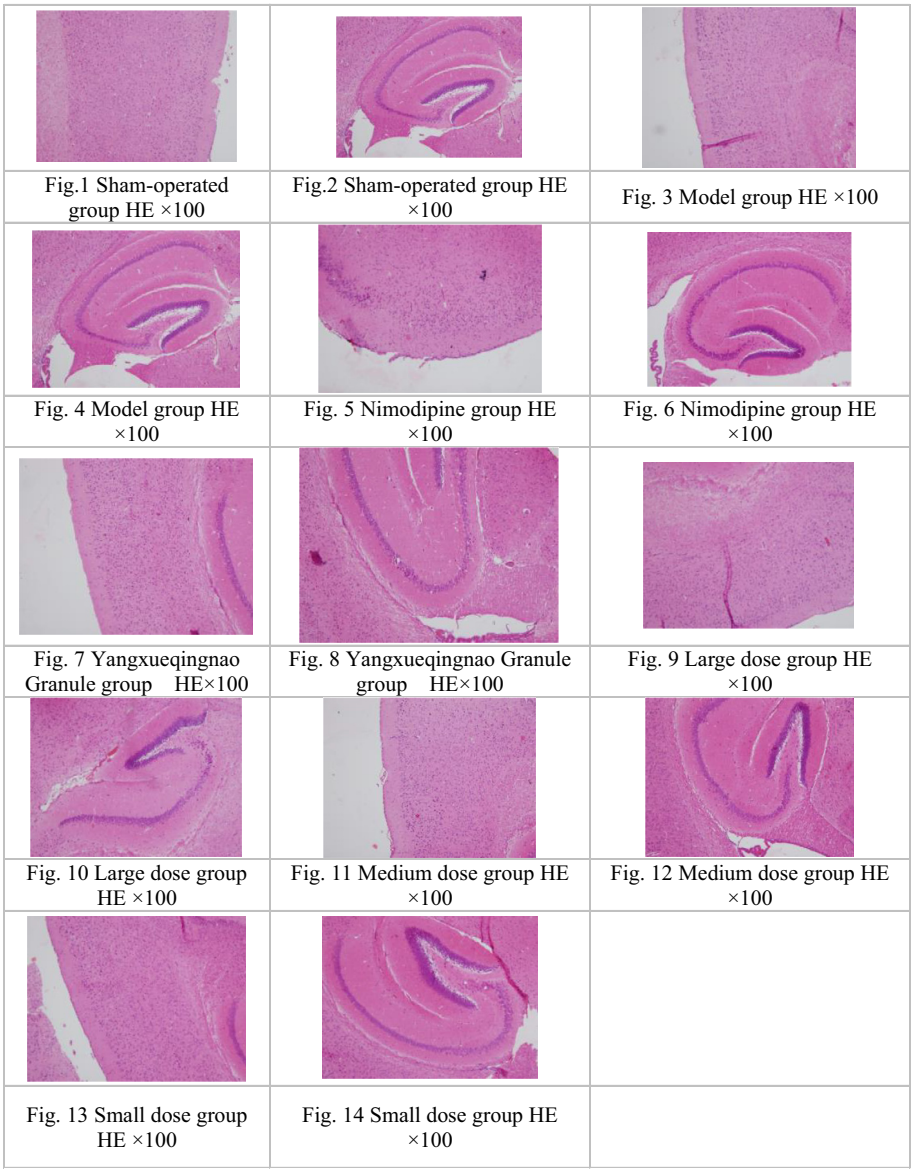

Fig.1 Sham-operated group HE ×100	Fig.2 Sham-operated group HE ×100	Fig. 3 Model group HE ×100
Fig. 4 Model group HE ×100	Fig. 5 Nimodipine group HE ×100	Fig. 6 Nimodipine group HE ×100
Fig. 7 Yangxueqingnao Granule group HE×100	Fig. 8 Yangxueqingnao Granule group HE×100	Fig. 9 Large dose group HE ×100
Fig. 10 Large dose group HE ×100	Fig. 11 Medium dose group HE ×100	Fig. 12 Medium dose group HE ×100
Fig. 13 Small dose group HE ×100	Fig. 14 Small dose group HE ×100	

Fig. 1. On the TIA model of rat brain tissue changes in the rate of nerve cells.

Current treatment of ischemic brain disease mainly use chemical drugs for treatment, but there are also serious side effects and other shortcomings. In recent years, under the principle of blood circulation and heat detoxification, Chinese medicine in the clinical treatment of cerebral ischemia has played a huge role (Li et al., 2013; Gohar et al., 2017).

Modern research found that the blood state of high concentration, high viscosity, high coagulation is an important reason for the induction of cerebral infarction, increased blood viscosity is one of the main indicators of observing cerebral ischemic disease (Shi et al., 2016; Bursa et al., 2017). TIA is a multi-etiological syndrome, one of the main etiological factor is based on the occurrence of atherosclerosis, generating blood flows slowly, blood composition changes, blood viscosity increases, the formation of micro-thrombosis or cerebral vasospasm and other causes (Zaheer et al., 2017. Therefore, determinating hemorheology changes in understanding the blood situation of TIA is of great significance. When cerebral ischemia occurs, there is insufficient blood supply in brain tissue, LD increased by sugar anaerobic metabolism, insufficient ATP production, decreased Na^+-K^+-ATPase activity, resulting in increased intracellular Na^+, causing cytotoxic brain edema and affecting cell function. While the decrease of Ca^{2+}-Mg^{2+}-ATPase activity can increase the degree of mitochondrial Ca^{2+} increase. Both made the energy metabolism process of the brain tissue cells slow down and increase brain damage. LDH is the most sensitive enzyme that reflects the degree of brain damage. In damage brain tissue, the activity of various oxygen-dependent enzymes also changes. LDH is abundantly present in the cytoplasm and mitochondria of neurons. When the cells are damaged by cerebral ischemia, these enzymes can be released into the cell gap and diffused into the cerebrospinal fluid, which enters the blood through the damaged blood-brain barrier. In the pathological state of the body, LDH activity increased, catalytic lactate dehydrogenation, may be the body to automatically adjust the protective compensatory mechanism (Rashid et al., 2017). Therefore, determinating LD, LDH, ATP enzyme can reflect the energy metabolism after cerebral ischemia (Zhou and Liu, 2017).

FGF is a polypeptide compounds of significant value-added effect, belonging to the intrinsic nerve growth factor. The increase of bFGF expression level can repair the brain tissue of cerebral ischemia-reperfusion injury in rats and promote its regeneration, and can play a role of neurotrophic by promoting endothelial cell

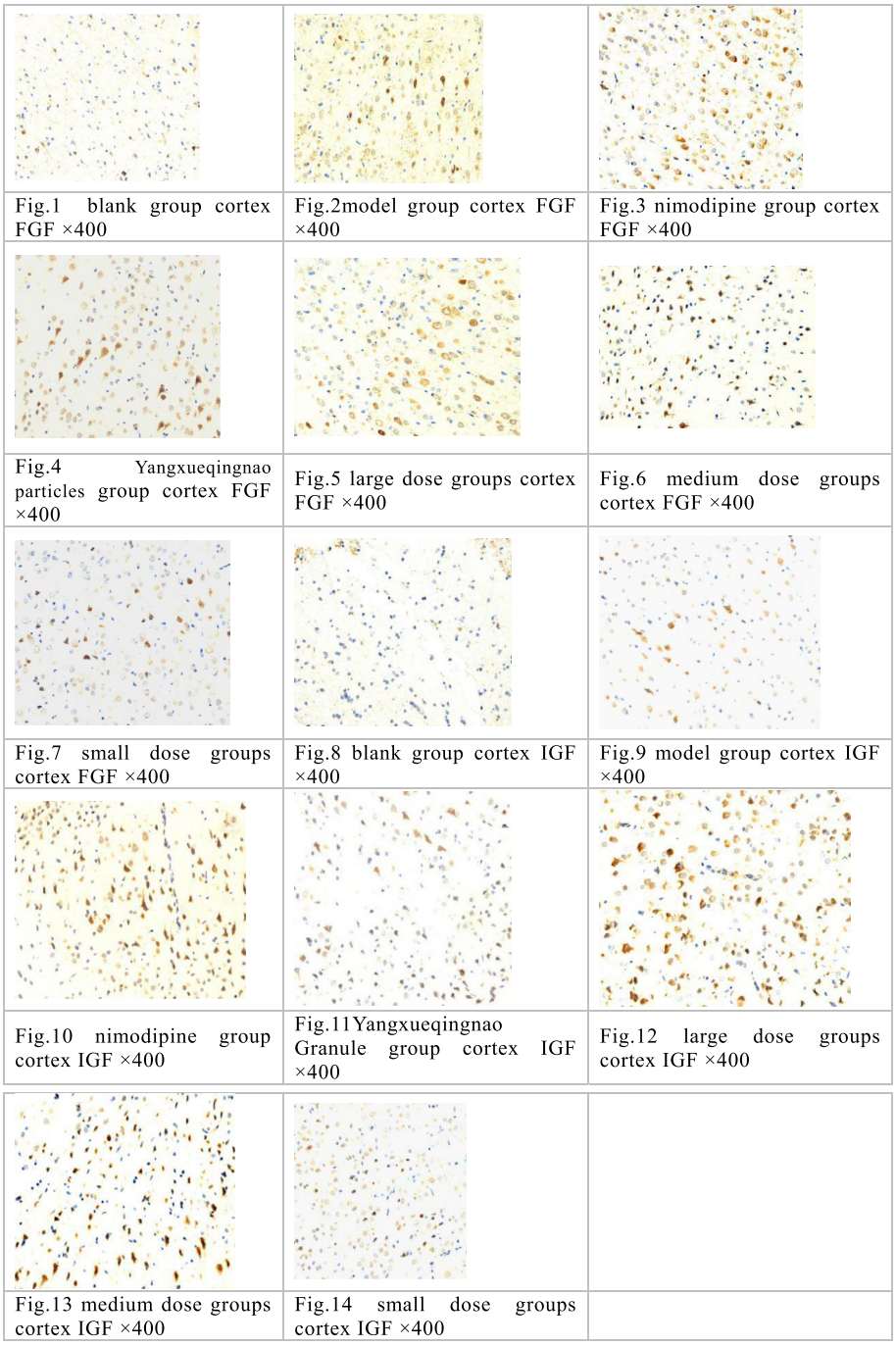

Fig. 2. Effect of Scrambling trumpet Creeper flavone on expression of FGF and IGF in cortex of TIA model rats.

division and differentiation, and restore the function of damaged central nervous system. Besides, bFGF can also improve the antioxidant enzyme activity, scavenging free radicals to prevent nerve cell apoptosis after ischemia-reperfusion injury. Increased expression of endogenous neurotrophic factor and its corresponding receptors in the brain tissue after cerebral ischemia-reperfusion injury can improve the damage state and protect the damaged brain tissue and maintain the activity of the various ganglia and nerves Yuan in the nervous system, improve synaptic growth capacity, and is conducive to the repair and survival of neurons. In addition, FGF can maintain the migration capacity and morphology of cells, promote the differentiation and repair of arterial endothelial cells in damaged tissue, and participate in the process of angiogenesis and cell proliferation in damaged tissues (Shi et al., 2016).

IGF is a factor with insulin-like metabolic effects, and has the role of promoting cell growth, mitosis, differentiation process, and involved in trauma repair and other important processes. IGF also exists in the brain tissue, and is an important regulatory factor of impacting brain development after fetal birth. Studies have shown that after brain tissue ischemia, the expression of related mRNA in the brain increased, and free state of IGF concentration increased, suggesting that the material can protect neurons. In addition, IGF can also have certain effect of induction toward the proliferation, differentiation of neuron and vascular endothelial cell, and improve cell's living environment. The above results show

Table 1
Effect of Scrambling trumpet Creeper flavone on behavioral Score of TIA rat model ($\bar{X} \pm s$).

Group	Animals (single)	Dose (mg kg^{-1})	First				Mortality rate(%)
			NDS	Latency (s)	Seizure frequency	Cumulative time (s)	
Sham-operated	15	–	0 ± 0**	—	0 ± 0**	—	0.00
Model	10	–	3 ± 0.7	314.0 ± 161.2	13.9 ± 3.1	223.5 ± 47.4**	33.3
Nimodipine	12	20	2.1 ± 0.6*	466.5 ± 171.0*	7.8 ± 2.2**	129.8 ± 38.7**	20.0
Yangxueqingnao particles	11	1000	2.2 ± 0.9*	480.3 ± 145.2*	8.8 ± 3.7**	148.5 ± 70.8**	26.7
Large dose	12	200	2.1 ± 1.1*	496.6 ± 139.5**	7.9 ± 3.2**	127.3 ± 39.3**	20.0
Medium dose	11	100	2.3 ± 1.1	390.3 ± 179.3	8.8 ± 3.4**	127.2 ± 47.1**	26.7
Small dose	10	50	2.7 ± 0.8	385.2 ± 181.3	9.9 ± 3.1**	133.4 ± 27.7**	33.3

Group	Animals (single)	Dose (mg kg^{-1})	Second			
			NDS	Latency (s)	Seizure frequency	Cumulative time (s)
Sham-operated	15	–	0 ± 0**	—	0 ± 0**	—
Model	10	–	2.9 ± 0.6	317.6 ± 158.4	12.8 ± 3.4	204.1 ± 42.2**
Nimodipine	12	20	1.9 ± 0.7**	488.2 ± 97.9**	7.6 ± 2.7**	136.1 ± 46.9**
Yangxueqingnao particles	11	1000	1.9 ± 0.5**	516.8 ± 106.2**	7.3 ± 3.0**	119.5 ± 42.1**
Large dose	12	200	1.9 ± 0.7**	507.2 ± 94.6**	7.6 ± 2.6**	122.3 ± 52.1**
Medium dose	11	100	1.8 ± 0.8**	501.9 ± 91.1**	7.7 ± 3.3**	124.5 ± 67.4**
Small dose	10	50	2.0 ± 0.5**	433.5 ± 104.9*	8.8 ± 2.4**	155.3 ± 46.7*

Note: Compared with the model group.
* P <0 .05.
** P < 0.01.

Table 2
The total flavonoids of the flower of TIA model of rat brain tissue changes in the rate of nerve cells ($\bar{X} \pm s$, %).

Group	Animals (single)	Dose (mg kg^{-1})	Cortical lesions by cell count	Hippocampal zone lesions nerve cell count
Sham-operated	15		5.8 ± 3.1**	7.8 ± 2.9**
Model	10	–	44.2 ± 8.3	49.2 ± 5.8
Nimodipine	12	20	30.6 ± 5.2**	36.0 ± 5.8**
Yangxueqingnao particles	11	1000	31.4 ± 6.0**	32.8 ± 3.8**
Large dose	12	200	35.2 ± 4.4**	34.7 ± 6.2**
Medium dose	11	100	38.7 ± 4.7*	43.6 ± 6.0*
Small dose	10	50	40.1 ± 6.7	45.5 ± 6.0

** P < 0.01.
* P <0 .05.

Table 3
Effects of flavonoids from curcuma flowers on whole blood viscosity of TIA model rats ($\bar{X} \pm s$, mPa s).

Group	Animal	Dose (mg kg^{-1})	Low cut	Medium cut	High cut
Blank group	15		16.463 ± 2.160**	8.649 ± 0.736**	6.199 ± 0.451 **
Model group	10	–	24.442 ± 3.729	12.231 ± 1.135	9.419 ± 1.207
Nimodipine group	12	20	17.339 ± 3.606**	9.194 ± 0.936 **	7.056 ± 0.531**
Yangxueqingnao Granule group	11	1000	18.016 ± 3.556**	10.259 ± 0.847 **	7.719 ± 0.649 **
Large dose groups	12	200	17.189 ± 1.449**	9.222 ± 0.539**	6.909 ± 0.366 **
Medium dose groups	11	100	19.451 ± 2.487**	9.988 ± 0.614**	7.242 ± 0.696**
Small dose groups	10	50	18.794 ± 1.797**	9.875 ± 0.790**	7.510 ± 0.559 **

Note: Compared with model group.
** P < 0.01.

Table 4
Effects of Scrambling trumpet Creeper flavone on plasma viscosity, hematocrit, ESR and coagulation time in TIA model rats ($\bar{X} \pm s$).

Group	Animal	Dose (mg kg^{-1})	Plasma viscosity (mPa s)	Hematocrit (cm h^{-1})	ESR (%)	Coagulation Time (s)
Blank group	15		1.541 ± 0.162**	1.66 ± 0.22**	56.1 ± 5.9**	109.8 ± 16.8**
Model group	10	–	1.993 ± 0.135	2.60 ± 0.41	76.8 ± 3.4	77.7 ± 8.3
Nimodipine group	12	20	1.612 ± 0.226**	1.92 ± 0.47**	62.9 ± 7.4**	103.0 ± 17.8**
Yangxueqingnao particles	11	1000	1.702 ± 0.202**	1.94 ± 0.34**	65.2 ± 6.1**	102.7 ± 14.2**
Large dose groups	12	200	1.609 ± 0.135**	1.91 ± 0.36**	63.7 ± 7.2**	95.8 ± 13.3**
Medium dose groups	11	100	1.706 ± 0.248**	1.97 ± 0.42**	69.4 ± 5.7**	92.4 ± 20.8*
Small dose groups	10	50	1.730 ± 0.112**	1.98 ± 0.36**	66.8 ± 6.2**	92.30 ± 15.3*

Note: Compared with model group.
* P <0 .05.
** P < 0.01.

Table 5
Effects of Scrambling trumpet Creeper flavone on whole blood reducing viscosity of TIA model rats ($\bar{X} \pm s$, mPa s).

Group	Animal	Dose (mg kg^{-1})	Low cut	Medium cut	High cut
Blank group	15		26.667 ± 3.307	12.752 ± 1.439	8.369 ± 0.949 **
Model group	10	–	29.348 ± 5.662	13.367 ± 1.795	9.704 ± 1.839
Nimodipine group	12	20	24.918 ± 3.799**	12.085 ± 0.721*	8.718 ± 0.805 *
Yangxueqingnao particles	11	1000	24.884 ± 3.646 **	13.180 ± 1.130	9.277 ± 0.952
Large dose groups	12	200	24.767 ± 3.707**	12.154 ± 2.104	8.436 ± 1.245*
Medium dose groups	11	100	25.683 ± 3.885*	12.014 ± 1.368*	8.015 ± 1.094 **
Small dose groups	10	50	25.619 ± 2.285*	12.243 ± 1.057	8.701 ± 0.864

Note: Compared with model group.
* P <0 .05.
** P < 0.01.

Table 6
Effects of Scrambling trumpet Creeper flavone on erythrocyte rigidity index, K-value and erythrocyte deformation index of TIA model rats ($\bar{X} \pm s$).

Group	Animal	Dose (mg kg^{-1})	Erythrocyte rigidity index	K-value	Erythrocyte deformation index
Blank group	15		5.430 ± 0.689**	13.217 ± 6.202**	0.900 ± 0.151**
Model group	10	–	8.668 ± 1.383	90.080 ± 41.475	0.577 ± 0.064
Nimodipine group	12	20	6.182 ± 1.478**	25.375 ± 16.774**	0.781 ± 0.142**
Yangxueqingnao particles	11	1000	6.273 ± 1.391**	28.335 ± 16.011**	0.719 ± 0.127*
Large dose groups	12	200	6.219 ± 1.257**	25.593 ± 13.855**	0.771 ± 0.134**
Medium dose groups	11	100	7.487 ± 2.402	38.517 ± 22.348**	0.692 ± 0.121*
Small dose groups	10	50	6.599 ± 0.863**	33.105 ± 20.297**	0.702 ± 0.078*

Note: Compared with model group.
* P < 0.05.
** P < 0.01.

Table 7
Effects of Scrambling trumpet Creeper flavone on Na^+ -K^+ -ATPase, Mg^{2+}-ATPase and Ca^{2+}-ATPase activity in TIA model rat bone homogenate ($\bar{X} \pm s$).

Group	Animal	Dose (mg kg^{-1})	Na^+ -K^+ -ATPase (μmolpi $mgprot^{-1}$ h^{-1})	Mg^{2+} -ATPase (μmolpi $mgprot^{-1}$ h^{-1})	Ca^{2+}-ATPase activity (μmolpi $mgprot^{-1}$ h^{-1})
Blank group	15		6.085 ± 0.668**	6.785 ± 1.146**	4.187 ± 0.926 **
Model group	10	–	4.019 ± 0.332	4.602 ± 0.774	2.202 ± 0.644
Nimodipine group	12	20	5.492 ± 0.831**	5.547 ± 0.923*	3.221 ± 0.440 **
Yangxueqingnao particles	11	1000	5.864 ± 0.833**	6.161 ± 1.071**	3.196 ± 0.365**
Large dose groups	12	200	5.634 ± 0.736**	5.257 ± 0.975	3.185 ± 0.966 **
Medium dose groups	11	100	5.287 ± 0.955**	6.447 ± 0.993**	3.213 ± 0.527**
Small dose groups	10	50	5.567 ± 0.909 **	5.930 ± 0.948**	3.240 ± 0.987 **

Note: Compared with model group.
* P <0 .05.
** P < 0.01.

Table 8
Effects of Scrambling trumpet Creeper flavone on LD content and LDH activity in TIA model rat bone homogenate ($\bar{X} \pm s$).

Group	Animal	Dose (mg kg^{-1})	LD (mmol $gprot^{-1}$)	LDH (U $gprot^{-1}$)
Blank group	15		0.292 ± 0.077**	61987.9 ± 8876 **
Model group	10	–	0.475 ± 0.064	32870.4 ± 8720.9
Nimodipine group	12	20	0.303 ± 0.058 **	42725.1 ± 5138.4 **
Yangxueqingnao particles	11	1000	0.337 ± 0.074**	43426.1 ± 5863.6**
Large dose groups	12	200	0.351 ± 0.053**	45754.2 ± 6198.5 **
Medium dose groups	11	100	0.361 ± 0.055**	46006.0 ± 6845.4**
Small dose groups	10	50	0.349 ± 0.051 **	36109.2 ± 5274.4

Note: Compared with model group.
** P < 0.01.

that IGF on the maintenance of the nervous system function has a very important role (Zhi et al., 2016; Gao et al., 2017). Therefore, we can observe the positive expression situation of IGF and FGF in the cerebral cortex of the rat to preliminarily explore the mechanism of Scrambling trumpet Creeper flavone against cerebral ischemia.

The results showed that the Scrambling trumpet Creeper flavone had a good effect on the rat TIA model, which could significantly improve the behavioral score of model rats and significantly reduce the number of hippocampus and cortical neuronal cell count, Significantly improved pathological changes in brain tissue. And decreased the blood viscosity, plasma viscosity, whole blood reduction viscosity, hematocrit, erythrocyte deformation index, erythrocyte sedimentation rate and erythrocyte sedimentation rate, significantly prolonged clotting time, significantly reduced the LD content in brain tissue, Tissue ATPase, LDH activity, increased brain tissue IGF, FGF positive expression, and thus play the role of anti-cerebral ischemia.

Table 9
Effects of Scrambling trumpet Creeper flavone on expression of FGF in cortex of TIA model rats (unit).

Group	n	–	+	++	+++
Blank group	15	8	7	0	0
Model group	10	2	8	0	0
Nimodipine group	12	0	1	4	7
Yangxueqingnao particles	11	0	1	7	3
Large dose groups	12	0	2	3	7
Medium dose groups	11	0	2	4	5
Small dose groups	10	3	3	4	0

Note: According to the results of immunohistochemical observation of different colors can be divided into four: "–" no color; "+" shows weakly positive; "++" shows positive; "+++" shows strong positive.

Table 10
Effects of Scrambling trumpet Creeper flavone on expression of IGF in cortex of TIA model rats (unit).

Group	n	–	+	++	+++
Blank group	15	9	6	0	0
Model group	10	3	7	0	0
Nimodipine group	12	0	2	3	7
Yangxueqingnao particles	11	0	2	5	4
Large dose groups	12	0	2	4	6
Medium dose groups	11	1	3	3	4
Small dose groups	10	2	3	4	1

Note: According to the results of immunohistochemical observation of different colors can be divided into four: "–" no color; "+" shows weakly positive; "++" shows positive; "+++" shows strong positive.

In summary, the Scrambling Trumpet Creeper flavone is the main active ingredient of Campsis grandiflora's anti-cerebral ischemic injury. It can improve the function of nerve function, the degree of brain tissue lesion and blood rheology, enhance the energy metabolism and increase the brain neurotrophic factor Expression, in which it could achieve the role of anti-cerebral ischemic injury.

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