

The influence of reflexology on the rheological properties of the blood of patients with  
cerebrovascular diseases

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Vascular diseases of the brain are one of the most important problems in medicine [2, 8]. The high prevalence of cerebrovascular diseases, a high percentage of disability and mortality determine the urgency of this problem [9]. The leading place in the structure of cerebrovascular diseases is currently occupied by ischemic lesions, in the pathogenesis of which a significant place belongs to disorders of the rheological properties of blood [3, 4, 10].

Stroke or, according to the terminology of ancient Eastern medicine, "wind blow" often occurs due to insufficient blood Qi or as a result of the fact that there is a deficiency in the lower heater, and redundancy in the upper one, that is, the harmony of Yin and Yang in Fu-organs is disturbed. The reasons for these phenomena are manifold [6]. "Wind blow" is divided into two options. The first occurs when violations are localized in the meridians and collaterals. The second - with the defeat of Zhani Fu-organs. Ischemic strokes often occur by the mechanism of the first option.

The aim of our work was to establish the effect of reflexology on the rheological properties of erythrocytes, as this can help to optimize the treatment of post-stroke patients.

#### Materials and methods

We studied the rheological properties of erythrocytes in 124 patients in the early recovery period of ischemic stroke and 64 people in the control group, who had no history of myocardial infarction, stroke or transient ischemic attacks, liver pathology, blood diseases. The ischemic nature of the stroke was confirmed by the data of computed and magnetic resonance imaging in 100% of cases.

All patients underwent a dynamic comprehensive examination (before the course of treatment and after its completion), including, in addition to standard examination methods, examination of a neurologist, reflexologist and other narrow specialists, computer anthropometry, polarography, a study of heart rate variability, a detailed biochemical blood test, as well as a study of rheological properties erythrocytes: deformability, aggregation and cytoarchitectonics of erythrocytes.

We carried out a dynamic observation of 46 patients (group 2 of strokes), who underwent reflexotherapy against the background of the standard therapy for the studied groups. Defeats of the meridians and collaterals during the "wind blow" may occur primarily or be observed after the restoration of the functions of the Zhani Fu organs, but stagnation of blood Qi remains in the meridians and collaterals, which is fully manifested in the symptom complexes of the postischemic period of stroke [7]. Taking into account this pathogenetic feature, we most often carried out rehabilitation treatment of post-stroke patients using the points of the posterior median meridian and Yang meridians of the affected side.

Acupuncture was performed daily for 14 days at a fixed time for each patient. After the session, the patients rested for 30 minutes. The acupuncture method was always determined individually - according to the clinical picture after a thorough diagnosis according to the canons of ancient Chinese medicine, but most often the points of the affected side were affected by a tonic method. First, they affected the meridians of the healthy side of the body, and then the affected one. Treatment began with a reflex effect on the altered reactivity and functional state of the nervous system [5].

The following points were used in the recipe: VG20 bai-hui, V7 tong-tian, VG16 feng fu; for the upper limbs - GI15 jian-yu, GI11 qu-chi, TR5 wai-guan, GI4 he-gu; for the lower extremities - VB30 huan-tiao, VB34 yang-ling-quan, E36 tszu-san-li, E40 tsze-hsi; additional points - sedated VB20 feng-chi, F3 tai-chun, toned R3 tai-si, RP6 san-yin-jiao; sedated

MC7 da-ling, F2 xing-jian, toned R3 tai-hsi; with neuropathy of the facial nerve, paresis or paralysis of the muscles of the mouth - E4 di-tsang and E6 chia-che.

Since the posterior meridian is the "sea of Yang meridians", its points VG20 bai-hui and VG16 feng fu, in combination with the point V7 tong-tian, can eliminate pathogenic wind and blockade of meridians, restore the circulation of Qi and blood in the upper and lower parts of the body. ...

When Yang energy was disturbed in the upper body, a combination of VB20 feng chi and F3 tai chun was chosen to expel wind and calm the liver. By toning R3 tai-si strengthened the energy of the kidneys; by toning RP6 san-yin-jiao "nourished" Yin, "calmed" Yang; sedating points MC7 daling and F2 xing-jian eliminated the "heat" of the heart and liver, toning R3 tai-si "nourished" Yin, weakening the "heat". The ti-tsang and E6 points of chia-che were influenced to restore the circulation of Qi in the meridians passing through the facial area.

Hemorheological indices of the group of patients with strokes, in which reflexotherapy was carried out, were compared at the end of the course of treatment with the indices of 78 people with ischemic strokes (IS) who did not receive reflexotherapy treatment (1st group of strokes), and those of the control group. The age and sex composition of the control group was comparable to the groups of the examined patients.

The deformability of erythrocytes was determined by the filtration method modified by R.R. Shilyaeva et al. (1991) using cellulose acetate membranes (pore diameter 3.5  $\mu\text{m}$ ). The essence of the method is to determine the initial filtration time [8]. The coefficient of erythrocyte deformability (EDC) was calculated.

Aggregation of erythrocytes was determined by a direct optical method in a Goryaev chamber. The following indicators were calculated: average aggregate size (CPA), aggregation index (PA), percentage of non-aggregated erythrocytes (PNA).

The assessment of the surface architectonics of erythrocytes in patients with strokes was carried out using the method of phase contrast microscopy after fixing the blood in 1% glutaraldehyde solution in Hanks' medium (pH 7.4) with the release of 10 main forms according to the classification of G.I. Kozinets et al. (1977). In addition, for a more detailed integral quantitative assessment of the morphology of erythrocytes, the following indicators were calculated: transformation index (IT), reversible transformation index (RTI), index of irreversible erythrocyte transformation (IROT), and transformation reversibility index (IR).

The data obtained were processed by the methods of variational analysis on a PC using the Microsoft Excel 7.0 application package. The significance of the differences was assessed using the Student's t-test. Differences were considered statistically significant at  $p < 0.05$ .

### Research results

Before the course of treatment, there was practically no significant difference between the rheological parameters in patients of the 1st and 2nd groups with IS. IS, in contrast to the control group, had a significant increase in PA to  $1.58 \pm 0.01$  ( $p < 0.001$ ), CPA to  $5.98 \pm 0.14$  ( $p < 0.001$ ) and a decrease in PNA to  $62.28 \pm 1.53$  ( $p < 0.001$ ) and KDE up to  $0.12 \pm 0.02$  ( $p < 0.001$ ). Cytoarchitectonics in IS changed as follows: a decrease in the number of discocytes to 71.13% ( $p < 0.001$ ) with a simultaneous increase in the number of reversibly and irreversibly changed cell forms to 14.79% ( $p < 0.001$ ) and 12.15% ( $p < 0.001$ ) respectively compared with the control group. In accordance with these changes in the groups of patients with IS, the IT was significantly increased to  $0.36 \pm 0.01$  ( $p < 0.001$ ), the IOT to  $0.18 \pm 0.02$  ( $p < 0.001$ ), the ITT to  $0.17 \pm 0.11$  ( $p < 0.001$ ) and reduced IO to  $0.84 \pm 0.12$  ( $p < 0.01$ ).

After the end of the standard therapy for the studied groups in the group of verified IS without reflexotherapy, pronounced hemorheological disorders were revealed: an increase in PA, CPA and a decrease in PNA and EDC relative to the control values. In the group of patients with IS with reflexotherapy treatment (IS with RT), PA, CPA were significantly reduced and PNA was increased in comparison with the control values. In this group, there was a tendency to a decrease in PA and CPA indices, as well as an increase in PNA, and a significant increase in EDC relative to the 1st group of IS (Table 1).

In persons with IS without reflexotherapy, compared with the control group, there is a decrease in the percentage of discocytes with a simultaneous increase in the number of reversibly altered and irreversibly altered cell forms. Among reversibly deformed red blood cells

echinocytes of the third and fourth classes prevailed. Among the irreversibly altered erythrocytes, both an increase in the content of stomatocytes and degenerative erythrocytes was noted. In accordance with these changes, IT, IOT, IOT were significantly increased and IO was decreased.

Table 1

## Aggregation and deformability in the study groups

Показатели	Группа обследованных			p* по группам
	1 Контроль	2 ИИ	3 ИИ с РТ	
Показатель агрегации	1,17 ± 0,03	1,48 ± 0,05	1,36 ± 0,05	p < 0,001 (1+2) p < 0,05 (1+3)
Средний размер агрегата	4,39 ± 0,26	5,83 ± 0,19	5,28 ± 0,29	p < 0,001 (1+2) p < 0,05 (1+3)
Процент неагрегированных эритроцитов	83,80 ± 2,31	66,33 ± 2,77	70,88 ± 3,67	p < 0,001 (1+2) p < 0,01 (1+3)
Коэффициент деформируемости эритроцитов	0,19 ± 0,01	0,13 ± 0,01	0,17 ± 0,01	p < 0,001 (1+2) p < 0,05 (2+3)

\*Недостовверные различия (p > 0,05) в таблице не указаны.

In the group of IS patients with RT, there was a decrease in comparison with the control indicators in the percentage of discocytes in the test blood, an increase in the number of reversibly deformed (due to erythrocytes of the second class) and irreversibly deformed erythrocytes (due to stomatocytes). When using reflexotherapy treatment of IS, there is a significant decrease in irreversibly deformed erythrocytes (due to erythrocytes in the form of a "deflated ball") and an increase in the number of reversibly deformed erythrocytes (due to echinocytes of the second class) relative to the 1st group of strokes (table 2).

table 2

Показатели	Группа обследованных			p* по группам
	1 Контроль	2 ИИ	3 ИИ с РТ	
Формы эритроцитов				
Класс 1	84,0 ± 0,6	74,3 ± 1,1	76,1 ± 1,5	p < 0,001 (1+2) p < 0,001 (1+3)
Класс 2	4,4 ± 0,3	5,7 ± 0,3	6,2 ± 0,5	p < 0,05 (1+3)
Класс 3	3,2 ± 0,5	5,1 ± 0,2	4,5 ± 0,6	p < 0,01 (1+2)
Класс 4	1,7 ± 0,2	3,5 ± 0,5	3,1 ± 0,7	p < 0,01 (1+2)
Класс 6	5,6 ± 0,6	9,4 ± 0,7	8,9 ± 1,0	p < 0,001 (1+2) p < 0,05 (1+3)
Класс 9	0,1 ± 0,2	0,2 ± 0,6	0,2 ± 0,1	–
Класс 10	1,0 ± 0,1	2,3 ± 0,3	1,4 ± 0,2	p < 0,01 (1+2)
Индекс				
Индекс трансформации	0,21 ± 0,01	0,38 ± 0,02	0,35 ± 0,02	p < 0,001 (1+2) p < 0,001 (1+3)
Индекс обратимой трансформации	0,13 ± 0,01	0,20 ± 0,01	0,19 ± 0,01	p < 0,001 (1+2) p < 0,001 (1+3)
Индекс необратимой трансформации	0,09 ± 0,01	0,18 ± 0,01	0,15 ± 0,02	p < 0,001 (1+2) p < 0,01 (1+3)
Индекс обратимости трансформации	2,23 ± 0,43	0,84 ± 0,11	1,05 ± 0,29	p < 0,01 (1+2) p < 0,05 (1+3)

\*Недостовверные различия (p > 0,05) в таблице не указаны.

## Changes in erythrocyte morphology in groups of strokes

## Discussions and conclusions

With verified IS without reflexotherapy treatment, pronounced

hemorheological disorders: aggregation increased, the deformability of erythrocytes and the percentage of discocytes decreased relative to the control group, with a simultaneous increase in the number of reversibly changed and irreversibly changed cell forms. In accordance with these changes in this group of patients, the indices of transformation, reversible and irreversible transformation significantly increased, and the index of reversibility decreased. Our results are consistent and in many respects supplement the literature data [1, 9, 10].

We have found that reflexology is able to correct cytoarchitectonic disorders and the associated deformability of erythrocytes in IS. Thus, in the group of IS patients with RT, compared with the 1st group of strokes, an increase in EDC, a significant increase in the number of reversibly deformed erythrocytes and a decrease in irreversibly deformed erythrocytes were noted. Thus, reflexotherapy of post-stroke patients leads to a statistically significant improvement in the deformability and cytoarchitectonics of erythrocytes, which makes it possible to propose reflexotherapy to optimize the treatment of patients with IS as a pathogenetically justified therapy.

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