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Influence of quercetin and lipoflavon on superoxide dismutase and catalase activity in experimental hemorrhagic stroke

Wpływ kwercetyny i lipoflawonu na aktywność dysmutazy ponadtlenkowej i katalazy w eksperymentalnym udarze krwotocznym

INTRODUCTION

In recent years, the theory of bioregulatory stereotypes has been developed, in which considerable attention is paid to the general properties of bioflavonoids. Excessive formation of reactive oxygen species and an increase of the process of free oxidation of lipids is the mechanism of damage to cells and tissues. Stopping these processes requires the introduction of drugs that are able to reduce the content of reactive oxygen species and reduce the intensity of reactions peroxide oxidation of lipids [4]. In recent years great emphasis has been paid to the study of mechanisms of free education for the development of various pathological conditions, and developing possible ways of correction with the use of antioxidants. This group of drugs represent drugs that inhibit the process of free-oxidation at different stages of cerebrovascular disease.

One of the most studied groups of biologically active substances are bioflavonoids a typical representative of which is quercetin, which is known to possess bioregulatory action [1]. In addition, quercetin is characterized with anti-inflammatory action of imunomoduluary properties, with almost no toxicity effect on certain enzymatic systems of the body [1]. At present, the treatment of cerebrovascular disease (hemorrhagic stroke) and other disorders of cerebral circulation is a very relevant medical and social problem. Hemorrhagic stroke is associated with significant violations of POL processes that lead to the destruction of lipid components of brain and other tissues [11].

Excessive generation of reactive oxygen species, which underlies many cerebrovascular pathologies, refers to the antioxidant system. The key role in its functioning and protecting cells from oxidative stress is superoxide dismutase and catalase, the enzymes that are the first line of protecting cells from free radicals. Violation of the antioxidant balance may be the result of changes in the mechanisms of antiradical protection. An important factor, which depends on the concentration of free radicals in cells of the body, is coordinated functioning of antioxidant systems. These enzymes are involved in clearance of activated oxygen species like superoxide anion and hydrogen peroxide.

The aim of this work was to clarify the biochemical mechanisms of the action of various forms of quercetin in experimental conditions of hemorrhagic stroke.

MATERIAL AND METHODS

In the experiments white rats of Vistar line male, weighing 180±10g, are maintained on a standard diet vivarium. Hemorrhagic stroke was caused by the described methods [5]. The drug lipoflavon produced by "Biolek" (Kharkiv) was injected intravenously in a dose of 10 mg/kg. The drug quercetin produced by Borschagovski chemical and pharmaceutical plant (Kyiv) was injected intravenously in a dose of 10 mg/kg. SOD and catalase activity were determined by spectrophotometric [2,10]. Statistical processing of results was performed using t-Student criterion at $P<0.05$ [1].

RESULTS AND DISCUSSION

It is known that one of the universal mechanisms of cell damage at the level of biological membranes is the process of LPO. The basis of cardiovascular pathological processes is violation of the integrity of membranes of cardiomyocytes and endothelial vessels, which leads to activation and phospholipase oxigenase which stimulate the formation of free radicals provoking a breach in the system of peroxide oxidation of lipids and affecting the processes in cells.

As indicators of the status of antioxidant protection we have chosen superoxide dismutase and catalase. Superoxide dismutase renders superoxide anion-radicals by their dysmutation and transformation in less reactive molecules of hydrogen peroxide and triplet oxygen. Catalase restores N_2O_2 with water. Results of researching the activity of SOD and catalase in the brain, spleen and kidneys under the experimental model of stroke are presented in tables 1 and 2. Analysis of experimental data indicates that in all investigated organs in experimental stroke activity of SOD and catalase compared with control the values significantly decreased. These results may indicate a sharp deceleration of antioxidant protection in a stroke, which may be the result of direct inactivation of antioxidant enzymes peroxide oxidation products [6].

Table 1. Superoxide dismutase activity (d. od. / mg protein • min) in various organs under conditions of experimental models of hemorrhagic stroke (M ± m)

Authorities	Control	Stroke		
		without the drug	introduction quercetin	introduction lipoflavon
Brain	0.64±0.08	0.42±0.08	0.68±0.05	0.81±0.06
Spleen	0.39±0.06	0.30±0.05	0.51±0.09	0.57±0.03
Kidney	0.15±0.02	0.10±0.05	0.25±0.04	0.28±0.03

* $p \leq 0.05$ compared with control, n = 5 in a series of studies

Table 2. Catalase activity (micromole of hydrogen peroxide / mg protein • min) in various organs under conditions of experimental models of hemorrhagic stroke (M ± m)

Authorities	Control	Stroke		
		without the drug	introduction quercetin	introduction lipo-flavon
Brain	3.67±0.44	2.22±0.17	4.72±0.21	5.68±0.72
Spleen	6.25±0.75	5.37±0.86	4.87±0.63	5.99±0.31
Kidney	3.83±0.56	2.85±0.58	3.92±0.47	3.34±0.51

* $p \leq 0.05$ compared with control, n = 5 in a series of studies

When using the drugs studied SOD activity changed. Thus, in an experimental stroke on the background of the drug quercetin the enzyme activity in the kidney increased almost twice and the spleen – 1.5 times, respectively. The activity of catalase in the introduction of quercetin increased in the brain and the activity in the spleen decreased, and kidneys are not significantly different from control values. The study of lipoflavon found that compared with control SOD activity increased in the brain, kidneys and spleen. The activity of catalase in the introduction of lipoflavon significantly increased in the brain, in kidneys – decreased, and in the spleen it did not differ from control values.

Thus, research results showed that hemorrhagic stroke was accompanied by a decrease in the target organ in rats, especially in brain tissue, activities of antioxidant enzymes such as SOD and catalase.

Introducing preparations with antioxidants properties (quercetin and lipoflavon) leads to the normalization process and functioning of the antioxidant system, as shown by increased activity of SOD and catalase.

Uncompensated activation of LPO processes, depletion of endogenous antioxidants and violation of regulatory mechanisms antiradical protection can be considered as a key level of damaged neurons.

Among the antioxidants of plant damage quercetin ranked second on the antioxidant effect after ubiquinon. Antioxidant action of flavonoids is due to their ability to neutralize reactive oxygen species and terminate the chain reaction of free radicals, especially quercetin [8]. Protective effects of flavonoids may be the result of their actions on the enzymatic system, and a combination of processes of direct disposal of free radicals and interaction with enzymes [3].

It was shown that these substances stabilize free radicals by interacting directly with the reactive component of radicals and thus turning them into more stable and less active. It was found that quercetin reduces the content of lipids in the blood, liver, spleen. Therefore, it is suggested that the main impact of flavonoids on the vascular system is associated with antioxidant activity of investigated substances [9].

CONCLUSIONS

As a result of the research we found that hemorrhagic stroke decreased the activity of antioxidant enzymes, and conditions for the introduction of quercetin. Superoxide dismutase and catalase activity returned to control values. Introduction of lipoflavon caused a more pronounced recovery of enzyme activity, especially in the brain of rats. Thus, the introduction of liposomes in the form of quercetin mainly led to normalization of POL processes violations resulting from hemorrhagic stroke.

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SUMMARY

The article deals with the peculiarities of processes of free radical oxidation of lipids under the influence of cerebrovascular pathology. The article also deals with the impact of medicines on these processes with the purpose of correcting cerebrovascular pathology through treatment and preventive means. We have shown that the use of antioxidant quercetin preparation leads to normalization of biochemical indications of tissue metabolism. It reveals that regulatory mechanisms participate in the formation of adaptive reactions under the given pathology. It has been shown that treatment with a medicine with antioxidant properties normalizes peroxidation processes. Thus, antioxidant medicine may be suggested both for prevention and complex treatment of cerebrovascular pathology.

Key words: hemorrhage apoplexy, quercetin, lipoflavon, liposomes, antioxidant

STRESZCZENIE

W artykule poruszono zagadnienia odrębności procesów oksydacji lipidów pod wpływem wolnych rodników w warunkach patologii mózgowo-naczyniowych, jak też wpływ środków leczniczych i prewencyjnych na te procesy w celu korekcji patologii mózgowo-naczyniowej. Stwierdzono, że użycie preparatów zawierających antyoksydant kwercetynę prowadzi do normalizacji wskaźników biochemicznych metabolizmu tkankowego i leczenie za pomocą preparatów antyoksydacyjnych normalizuje procesy peroksydacji. Leki antyoksydacyjne mogą być stosowane zarówno w prewencji, jak i złożonym leczeniu schorzeń mózgowo-naczyniowych.

Słowa kluczowe: mózgowy udar krwotoczny, kwercetyna, lipoflawon, liposomy, antyoksydant