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BIOCHEMICAL MARKERS OF PATHOLOGY IN RAT KIDNEYS AFTER "MILD" STRESS

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Abstract

Background. It is known that stress negatively affects the condition of the kidneys, activating oxidative stress in them.

Aim. To investigate the effect of "mild" stress on biochemical markers of pathology, such as the level of proteolysis, the state of the kallikrein-kinin system, and the rate of oxidation processes.

Methods. "Mild" stress was induced in rats by exposure to −20 °C for 5 minutes. 5 and 24 hours after stress, the rate of casein hydrolysis (pH 7,6) was determined in kidney homogenates by the Kunitz method, the activity of BAEE esterase by the spectrophotometric method, and the rate of ascorbic acid oxidation.

Results. Stress causes a significant decrease in proteolysis activity after 24 hours and a significant increase in the rate of ascorbic acid oxidation after just 5 hours.

Conclusion. "Mild" stress reduces the level of proteolysis, but significantly increases the level of oxidation, which can be considered a protective reaction.

Keywords: stress; kidneys; pathology markers; proteolysis; oxidative stress.

Introduction

Kidneys are one of the most important organs for the body's vital functions. Every year the number of patients with kidney diseases increases, largely due to stressful situations [1, 2]. Various methods are used to assess the pathological state of the kidneys, both functional and biochemical [3].

As is known, the pathological state of any organ, including the kidneys, includes the development of oxidative stress [4-6], as well as the activation of hydrolytic, in particular proteolytic, processes [7].

The goal of our work was to determine the impact of stress on the condition of the kidneys using such biochemical markers of pathology as the level of proteolysis and oxidation.

Materials and research methods

The experiments were conducted on 15 white Wistar rats (males, 180-220 g), which were divided into 3 groups: 1st - control, 2nd - "mild" stress, 5 hours, 3rd - "mild" stress, 24 hours. Stress was induced by exposing the rats to a temperature of −20 °C for 5 minutes.

After euthanasia of rats under thiopental anesthesia by total bleeding from the heart, kidneys were isolated, and the level of pathology markers was determined in the homogenate of which. The activity of proteolysis was determined by the rate of hydrolysis of casein at pH 7,6 (Kunitz method) [8]. The state of the kallikrein-kinin system was determined by the rate of hydrolysis of BAEE (benzoyl-arginine-ethyl ether) pH 7,6 [7]. The level of oxidation was determined by the rate of oxidation of ascorbic acid [9]. The protein content in the homogenates was determined by the Lowry method [8].

Statistical processing of the experimental results was carried out using generally accepted methods.

Results and discussion

Table 1 presents the results of determining the activity of casein hydrolysis (pH 7,6), which shows that the level of proteolysis in the kidneys begins to decrease already 5 hours after “mild” stress and decreases by half after 24 hours.

Table 2 shows that the rate of hydrolysis of BAEE does not differ significantly from the control indicator, although there is a certain tendency to increase.

Table 3 presents the results of determining the state of peroxidation processes in the

kidneys after “mild” stress by the rate of oxidation of ascorbic acid. It is seen that stress causes a significant (more than 7 times) increase in the level of oxidation, which may indicate an important role of oxidative stress in the development of kidney pathology [1, 2]. On the other hand, oxidative processes can detoxify kidney toxins, which negatively affect the condition of the heart [1, 10].

Changes in the level of biochemical markers of pathology are more clearly shown in the figure.

Table 1. The effect of stress on the activity of proteolysis
(substrate casein, pH 7.6) in the kidneys of rats

№ group	Group	Activity, ng/min·g	Specific activity, ng/min·mg protein
1	Control	8724±1350	168±24
2	Stress, 5 hours	6544±1045 p>0,05	124±18 p>0,05
3	Stress, 24 hours	4630±796 p<0,05	84±13 p<0,05

Table 2. The effect of stress on BAEE-esterase activity
(substrate benzoyl-arginine ethyl ester) in rat kidneys

№ group	Group	Activity, nmol/min·g	Specific activity, nmol/min·mg protein
1	Control	278,1±29,0	5511±720
2	Stress, 5 hours	302,8±18,8 p>0,05	5510±880 p>0,3
3	Stress, 24 hours	319,1±30,7 p>0,05	5758±746 p>0,3

Table 3. The effect of stress on oxidative activity
(rate of ascorbic acid oxidation) in rat kidneys

№ group	Group	Activity, μg/min·g	Specific activity, μg/min·mg protein
1	Control	7,693±1,105	0,146±0,019
2	Stress, 5 hours	55,026±9,300 p<0,01	0,862±0,142 p<0,01
3	Stress, 24 hours	38,220±4,250 p<0,01	0,694±0,095 p<0,01

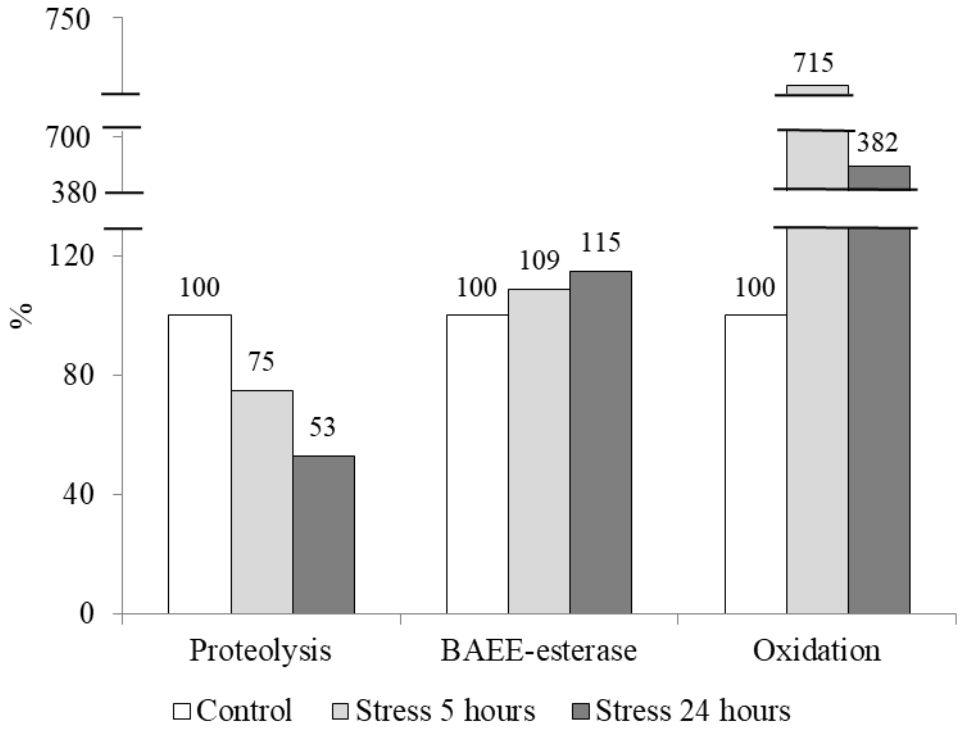

Fig. Relative level of pathology markers in rat kidneys after stress (5 and 24 hours)

Conclusion

"Mild" stress reduces the level of proteolysis in the kidneys, but significantly increases the level of oxidation, which can be considered as a protective reaction.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

All information is publicly available and data regarding this particular patient can be obtained upon request from corresponding senior author.

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