Reparative Activiti of Pharmacological Preparations under Sublethal Microwave Thermal Stress

A.T.Grechko

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 125, No. 2, pp. 172-174, February, 1998
Original article submitted December 26, 1996

Reparative activities of pharmacological drugs (total number 23) were investigated in male albino rats exposed to acute sublethal microwave thermal stress (from the first hours to the seventh day). Some drugs (BAD-1, Vitavis, cortexin, nootropile) accelerated adaptive and reparative processes in the brain and the body by normalizing various functional and biochemical parameters.

Key Words: *microwave thermal stress; functional reparation; pharmacological preparations*

High-power electromagnetic irradiation (HP IMR) affects continually both the personnel working with a generator of electromagnetic radiation and the inhabitants of neighboring areas [7-10]. The neglect of industrial safety provisions and nonregular staff situations happen rarely enough [2,7-11]. For rehabilitation of the victims of irradiation [2,3,7-9,12] it is necessary to select effective pharmacological preparations. Our aim was to investigate the effectiveness of a number pharmacological preparations for protection against radioactive damage.

MATERIALS AND METHODS

Screening of drugs was performed on male albino rats (body weight 180-200 g) divided in groups 20 animals each, using a model of acute sublethal microwave thermal stress and methods for estimation of its pathogenesis [5]. The following drugs were studied: nootropil (50 mg/kg), amthysol (20 mg/kg), quatherin (25 mg/kg), threemin (50 mg/kg), dibazol (15 mg/kg), ethymisole (2.5 mg/kg), ethomersol (25 mg/kg), almide (20 mg/kg), T-activin (1.0 mg/kg), thymalin (1.0 mg/kg), thymogen (1.0 mg/kg), cortexin (1 mg/kg), cerebrolysine (0.1 mg/kg), yakton (20 mg/kg), pirroxan (2.5 mg/kg), sidnocarb (3 mg/kg), and Vitavis adaptogen (10 mg/kg) [6]. The drugs were injected intraperitonealy. Other drugs were injected subcutaneously — dalargin (1 mg/kg), cyclic derivate of enkefalin (1 mg/kg), BAD-1 (0.1 mg/kg), and δ-sleep peptide analog (2.5 mg/kg). Ginseng and eleuterocock (1 ml each) tinctures were given perorally. All drugs were injected on the 10th-15th min after irradiation and then twice daily. Intact and control animals received an equal volume of normal saline. Monitoring of animals' status was carried out during the first 6-7 h and then on days 1, 7, and 15 after irradiation. Drugs were chosen on the basis of previous studies and the recommendations of other researchers [1,4,6].

RESULTS

On the grounds of observed intergroup differences on days 1 and 7 estimated by basic express-tests and loading assays (Table 1) the drugs were divided in two groups according to their protective and reparative activities:

a) high activity — BAD-1 (1.80-2.11), Vitavis (1.76-1.87), cortexin (1.60-1.65), noothropil (1.49-1.62);

b) medium activity (1.42-1.30) — cyclic derivat of enkephaline, quaterin, threemin, ethymisol, almid, ethomersol.

For other drugs the differences in activity were insignificant compared with the control. The highly

Military Medical Academy, St. Petersburg

0007-4888/98/0002-0148$20.00

TABLE 1. Effect of Drugs on Dynamics of Functional Recovery after Acute Sublethal Microwave Thermal Stress (*M±m*)

Groups, time interval		Movement activity in open field during 5 min	Conditioned reflex of active avoiding		Physical endurance (swimming time), min	Resistance to hypoxia, min	Muscular tonus and locomotory coordination, number of pivot rotations per minute		
			irradiation time, sec	number of combinations before criterion			6	12	18
Intact, imaginary irradiation	during 1 h	1031±69	364±18	10.6±0.6	663±14	47±4	250±12	142±7	44±2
	on 1 day	1067±63	232±6	7.4±0.4	674±10	46±3	242±10	167±8	77±4
	on 7 day	1043±41	122±4	4.6±0.3	682±11	45±3	249±9	166±7	79±4
Control, after thermal stress	during 1 h	refusing 83.3%	—	—	144±6*	21±4*	refusing	57.1%	
	on 1 day	443±11*	529±34*	18.8±1.5	252±6*	39±3*	145±11*	49±4*	7±1*
	on 7 day	629±27*	387±29*	11.2±0.9	398±8*	43±3*	176±9*	93±5*	71±2*
BAD-1, after thermal stress	during 1 h	refusing 39.7%	—	—	1.19±0.8	1.18±0.	refusing 31.4%		
	on 1 day	1.34±0.7**	1.67±0.6**	1.73±0.8**	1.39±0.6**	1.15±0.6	1.52±0.4**	1.66±0.5**	4.12±0.5**
	on 7 day	2.69±0.5**	2.03±0.5**	2.31±0.6**	2.08±0.7**	1.26±0.5**	1.88±0.3**	1.91±0.6**	3.39±0.4**
Vitavis, after thermal stress	during 1 h	refusing 44.5%	—	—	1.22±0.7	1.21±0.6**	refusing 33.9%		
	on 1 day	1.37±0.6**	1.63±0.6**	1.52±0.7**	1.46±0.5**	1.11±0.5	1.50±0.5**	1.44±0.4**	4.32±0.6**
	on 7 day	2.35±0.6**	1.84±0.6**	1.83±0.5**	1.87±0.6**	1.06±0.5	1.98±0.5**	1.79±0.5**	2.67±0.6**
Cortxin, after thermal stress	during 1 h	refusing 49.3%	—	—	1.13±0.9	1.13±0.5	refusing 44.1%		
	on 1 day	1.29±0.5**	1.48±0.6**	1.58±0.6**	1.26±0.7	1.06±0.3	1.33±0.4**	1.30±0.5**	3.51±0.8**
	on 7 day	1.88±0.5**	1.71±0.5**	1.88±0.5**	1.69±0.5**	1.05±0.3	1.41±0.4**	1.58±0.5**	2.03±0.6**
Noothropil, after thermal stress	during 1 h	refusing 62.2%	—	—		1.20±0.7	1.16±0.5	refusing 47.7%	
	on 1 day	1.33±0.7**	1.46±0.5**	1.45±0.5**	1.28±0.6**	1.09±0.4	1.32±0.5**	1.38±0.5**	2.59±0.7**
	on 7 day	1.91±0.6**	1.69±0.5**	1.76±0.5**	1.72±0.6**	1.07±0.4	1.46±0.6**	1.47±0.5**	1.87±0.5**

Note: Results of drugs administration were compared with control (taken as 1). $p<0.05$: *comparing with intact rats, **comparing with control.

active drugs are characterized by quick (several hours) restoration of the body functions, including high integrative functions in brain (learning, memory, recalling of information, extrapolation, forming of operative acceptor of action) as tested by conditioned-reflectory defensive behavior. The rotating rod-test showed restoration of muscle tones, coordination of movements, and also the ability to physiological stereotypes under monotonous physical exercises. After the same time periods the high forms of zoosocial behavior hierarchic, cooperative, and grooming behavior were recovered. These drugs also enhanced the resistance of rats to the swimming stress, due to restoration of brain function and optimization of metabolic processes. The drugs also increased the resistance to hypoxia in a low pressure altitude chamber. Pathomorphological manifestations of distress were weaker 1.27-1.94 times, as estimated by the development of microhemorrhages in stomach epithelium, adrenal hyperplasia and thymic involution. Biochemical parameters affected by thermal stress were restored [5]. Intragroup differences of high activity drugs estimated by biochemical parameters were inconsiderable but they differed significantly compared with the control and other drugs.

The interrelationships inside the dynamics of reparative processes become more obvious taking into account the properties and mechanisms of action of the investigated drugs which have been referred to as quick-acting adaptiogens [4,6]. Their regulatory effect is accompanied by optimization of cell bioenergetics (gluconeogenesis) and significant stimulation of nucleic acids and protein synthesis in the organs, tissues, and cells where residual adaptive and reparative processes occur.

Thus, this study confirmed the universal character of protective and reparative features of quick-acting adaptiogens and expanded the recommendations for using well-known pharmacological drugs as protectors against HPE EMI.

REFERENCES

1. B. M. Vinogradova and A. T. Grechko, *Farmakol. i Toksikol.*, No. 4, 5-9 (1982).
2. I. R. Petrova (Ed.), *Influence of SHF-irradiations on humans and animals organisms*, [in Russian], Leningrad (1970).
3. E. V. Gembitskiy, *Trudy Voenno-Meditsinskoi Akademii*, **166**, 121-128 (1966).
4. V. R. Gofman and A. T. Grechko, *Zhurn. Ushnykh, Nosovykh i Gorlovykh Boleznei*, No. 5, 29-34 (1994).
5. A. T. Grechko, *Byull. Eksp. Biol. Med.*, **118**, No. 11, 502-504 (1994).
6. A. T. Grechko, *Mezhdunar. Med. Obzhory*, **2**, No. 5, 330-333 (1994).
7. B. I. Davydov, *Kosm. Biol.*, **19**, No. 3, 8 (1985).
8. B. I. Davydov, V. S. Tikhonchuk, V. V. Antipov, *Biological influence, rate setting and protection against electromagnetic irradiation* [in Russian], Moscow (1984).
9. B. I. Davydov, V. S. Tikhonchuk, and V. G. Zuev, *Kosm. Biol.*, **23**, No. 1, 4-11 (1989).
10. O. P. Lomov, in: *Hygienic bases of dwelling/inhabitness of ships and crafts/vessels* [in Russian], Moscow (1989) pp. 82-95.
11. V. M. Lyutikov and B. L. Golyakov, *Voen.-med. zhurn.*, No. 10, 69-70 (1991).
12. N. V. Tyagin, *Clinical aspects of irradiation in SHF diapason* [in Russian], Leningrad (1971).