Changes in Stomach Motor-Secretory Function during Immobilization and Pain Stress and Their Correction with Bioactive Food Supplement Lymphosan

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We studied the effects of immobilization and pain stress on motor and secretory function of the stomach in dogs and correction of these changes with bioactive supplement Lymphosan. The stress factors induced pronounced changes in physiological parameters: immobilization stress induced hypersecretion, while pain stress inhibited the glandular apparatus. In animals treated with Lymphosan, both stress factors produced less pronounced changes and motor and secretory functions of the stomach were near to the control level. Thus, when used as a corrector of stress reactions, Lymphosan produced adaptogenic effects on the stomach and normalized the stress-induced disturbances.

Key Words: *stress; biologically active supplement; stomach*

The problems of stress and adaptation belong to the most acute challenges in the present style of human life. Under urban conditions, domestic animals are exposed to various stress factors such as traumas and surgical interventions associated with pain and immobilization. The stress is known to the major etiological factor promoting the development of various pathologies, including gastrointestinal diseases. Ulceration of the stomach during immobilization is regular phenomenon, which made it possible to include this symptom into the alarm reaction triad, which characterized the effect of various stress-factors: burn, cooling, immobilization, surgical trauma, *etc*. [1,7]. Painful stimulation and immobilization inhibit gastric secretion, while long-term exposure to these factors resulted in periodic alternations of hyper- and hyposecretion [4,6].

Administration of various adaptogenic food supplements can moderate or prevent the stress reactions, thereby maintaining or even increasing vital tonus of the animal [2,3,8].

Our aim was to study the effect of immobilization and pain stress on basic functions of the stomach in dogs and to evaluate the effects of food supplements as correctors of stress-provoked reactions.

MATERIALS AND METHODS

The experiments were carried out on random-bred male dogs (n=10) aging 2-3 years and weighing 10-15 kg. The animals were maintained on standard ration prepared from dry food for dogs.

Immobilization stress was induced by fixation in the supine position for 2 h. Pain stress was modeled by applying a tourniquet on the paw for 15 min. For correction of the stress reactions, bioactive supplement Lymphosan was added to the ration 4 days before and throughout the experiments.

Two experimental series were carried out: in series I, the animals received no treatment (controls) and in series II, the dogs received Lymphosan in a

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dose of 0.1 g/kg. The baseline and experimental values of major gastric indices were measured before and during administration of Lymphosan, respectively.

The digestive function of the stomach was examined on dogs with gastric fistula mounted according to Basov method. The motor function of the stomach was assessed by bioelectric activity of the mucosa [5]. The electric potentials were recorded on an H-373-1 microvoltammeter. The gastrograms were analyzed to obtain EMF and slow wave (SW) amplitude and frequency. The amplitude of each oscillation was measured in mV from its base to the peak. The frequency was measured as the number of oscillations per minute.

The secretory function of the stomach was evaluated by changes in gastric juice secretion. Portions of gastric juice were collected every hour at fast, purified from admixtures using ashless filters, and examined on the day of the experiment. pH was measured on a PH-150 pH-meter. Total acidity, free, and bound HCl was determined by titration according to Tepfer. Pepsin activity was measured by the method of N. P. Pyatnitskii and expressed in Pyatnitskii units (PU).

RESULTS

Baseline (before stress) parameters of motor and secretory functions of the stomach in animals receiving Lymphosan were higher than in controls: SW frequency and amplitude surpassed the control levels by 2.5% and 17.6%, respectively. EMF decreased by 144% and became positive (Table 1). Lymphosan increased secretion of the gastric juice by 183.3%, total acidity by 24.8%, free and bound HCl by 64 and 58.9%, respectively, and pepsin activity by 17.4%, and shifted pH to the acid direction by 6.1% (Table 2).

Immobilization stress also changed motor and secretory functions of the stomach: SW frequency decreased by 6.8%, SW amplitude increased by 20.6%, and EMF increased by 100% (Table 1). Moreover, secretion of the gastric juice increased by 117.8%, total acidity by 9.3%, free and bound HCl by 81.1 and 4.2%, respectively, pepsin activity by 14.6%, and pH decreased by 3% (Table 2).

Immobilization of Lymphosan-treated dogs decreased SW frequency by 4.1% in comparison with the initial value, but it remained above the control level (by 5.5%). SW frequency and amplitude decreased by 12.5% and 14.6%, respectively. EMF increased by 445% relatively to baseline value and decreased by 24% in comparison with the control. Moreover, secretion of the gastric juice decreased by 34.9% compared to baseline value and by 15.3% compared to the control, total acidity by 17.2 and 5.5%, respectively, free HCl by 20.4 and 20.4%, bound HCl by 36.8 and 3.6%, pepsin activity by 13.6 and 6.0%, and pH increased 6.5 and 3.1%.

Pain stress in control animals increased SW frequency by 9.3%, SW amplitude by 26.5%, and EMF by 28%. Increased potential of the mucosa is a physiological manifestation of inhibition of gastric glands, which was experimentally proved in various methodical paradigms. For example, it was observed under the effect of other factors inhibiting gastric secretion, such as nociceptive stimulation [6]. In our experiments, pain stress *per se* decreased secretion of gastric juice by 21.1%, total acidity

TABLE 1. Effect of Lymphosan on Bioelectric Activity of the Stomach during Immobilization or Pain Stress

Index		Before stress (baseline)	Immobilization stress	Difference, %	Pain stress	Difference, %
SW frequency, min^{-1}						
	control	11.80±0.07	11.00±0.09	-6.8***	12.9±0.1	9.3***
	experiment	12.10±0.09	11.60±0.08	-4.1**	11.70±0.08	-4.1**
Difference, %		2.5*	5.5***	—	-10.1***	—
SW amplitude, mV						
	control	0.340±0.008	0.410±0.009	20.6***	0.43±0.01	26.5***
	experiment	0.400±0.009	0.350±0.008	-12.5**	0.33±0.01	-17.5***
Difference, %		17.6***	-14.6***	—	-23.3***	—
EMF, mV						
	control	-2.5±0.15	-5.0±0.2	100.0***	-3.2±0.1	28.0**
	experiment	1.1±0.1	-3.8±0.1	445.5***	-2.30±0.15	309.1***
Difference, %		144.0***	-24.0***	—	-28.1***	—

Note. Here and in Table 2: *$p<0.05$, **$p<0.01$, ***$p<0.001$ (Student's test).

TABLE 2. Effect of Lymphosan on Secretory and Enzymatic Function of the Stomach during Immobilization or Pain Stress

Index		Before stress (baseline)	Immobilization stress	Difference, %	Pain stress	Difference, %
Secretion, ml/h						
	control	9,9.0±0.3	19.6±0.7	117.8***	7.1±0.2	—21.1***
	experiment	25.5±2.1	16.6±0.6	-34.9**	10.2±0.6	-71.3***
Difference, %		183.3***	-15.3±0.6**	—	43.7***	—
pH	control	3.30±0.04	3.20±0.04	-3.0***	3.60±0.03	-9.1***
	experiment	3.10±0.03	3.30±0.05	6.5***	3.40±0.04	9.7***
Difference, %		-6.1***	3.1**	—	-5.6***	—
Total acidity, titer unit						
	control	75.3±1.4	82.3±1.5	9.3**	60.8±1.3	-19.3***
	experiment	94.0±2.1	77.8±1.8	-17.2***	70.1±1.4	-25.4***
Difference, %		24.8***	-5.5*	—	15.3***	—
Free HCl, titer unit						
	control	27.5±1.2	49.8±2.5	81.1***	21.7±1.0	-21.1**
	experiment	45.1±2.0	35.9±1.3	-20.4**	26.1±0.9	-42.1***
Difference, %		64.0***	-20.4***	—	20.3**	—
Bound HCl, titer unit						
	control	26.3±0.2	27.4±0.2	4.2**	20.3±0.5	-22.8***
	experiment	41.8±1.8	26.4±0.9	-36.8	24.3±0.8	-41.9
Difference, %		58.9***	-3.6**	—	19.7**	—
Pepsin, U						
	control	13.8±0.3	14.9±0.2	14.6*	7.8±0.2	-43.5***
	experiment	16.2±0.4	14.0±0.4	-13.6**	14.3±0.3	-11.7**
Difference, %		17.4***	-6.0*	—	83.3***	—

by 19.3%, free and bound HCl by 21.1% and 22.8%, pepsin activity by 43.5%, and shifted pH towards the alkaline direction by 9.1%.

In Lymphosan-treated dogs, pain stress decreased SW frequency by 4.1% in comparison with the initial level and by 10.1% in comparison with the control. SW amplitude decreased by 17.5% and 23.3%, respectively. By contrast, EMF increased by 309.1% compared to the initial level and decreased by 28.1% in comparison with the control level. Pain stress changed parameters of the motor and secretory function of the stomach: secretion of gastric juice decreased by 71.3% compared to the baseline value and increased by 43.7% compared to the control, total acidity decreased by 25.4 and increased by 15.3%, respectively, free HCl decreased by 42.1 and increased by 20.3%, bound HCl decreased by 41.9% and increased by 19.7%, pepsin activity decreased by 11.7 and increased by 83.3%, respectively, and pH increased by 9.7 and decreased by 5.6%, respectively.

Thus, immobilization and pain stress induced different changes in functional parameters of the stomach. For example, changes in motor and secretory function of the stomach induced by immobilization stress manifested in hypersecretion, which indicates the disturbances of digestion in the stomach. The changes induced by pain stress attest to functional inhibition of the glandular apparatus impairing digestion in the stomach and assimilation of nutrients.

In dogs treated with Lymphosan, immobilization or pain stress produced only minor changes in the motor and secretory function of the stomach: the corresponding indices of gastric function little differed from the initial physiological levels and changes less pronounced than in experimental dogs not treated with Lymphosan. Thus, Lymphosan produced an adaptogenic effect on the stomach manifested in normalization of gastric indices under the influence of stress factors.

REFERENCES

1. L. Kh. Garkavi, E. B. Kvakina, and M. A. Ukolova, *Adaptive Reactions and Resistance of the Organism* [in Russian], Rostov-on-Don (1990).
2. Yu. I. Dobryakov, I. F. Nesterenko, and M. I. Polozhentseva, *Valeologiya*., No. 3, 90-100 (1996).

3. P. S. Zorinov and G. N. Bezdetko, in: *Biological Studies in Mountain Taiga Station of Far Eastern Subdivision of RAMS* [in Russian], No. 2 (1995), pp. 149-158.
4. F. Z. Meerson, *Adaptive Medicine: The Mechanisms and Protective Effects of Adaptation* [in Russian], Moscow (1993).
5. V. D. P'yanov, *Appetite and Its Regulation in Animals* [in Russian], Omsk (1999).
6. V. D. P'yanov, M. S. Galitskaya, and E. S. Shutenkov, *Proc. N. E. Bauman KSAVM*, **179**, 265-271 (2004).
7. L. P. Filaretova, *Ross. Fiziol. Zh.*, **81**, No. 3, 50-53 (1995).