Contractile Activity of Gastroduodenal and Ileocecal Zones during Stress in Rabbits

T. P. Berezina and V. I. Ovsyannikov

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Chronic experiments on rabbits showed that stress modeled by immobilization in the supine position induced different motor reactions in the gastroduodenal and ileocecal zones. Stress inhibited contractile activity in the stomach antrum, distal ileum, ileocecal valve area, and proximal colon and stimulated it in the duodenum. In the pyloric portion of the stomach both the inhibitory and potentiating effects of stress were observed.

Key Words: *stress; gastroduodenal and ileocecal motility*

Changes in the gastrointestinal motility manifested in modulation of the gut and stomach contractile activity and chyme passage along the gastrointestinal tract (GIT) are an essential component of body reaction to stress. Stress inhibits chyme evacuation from the stomach, decelerates chyme passage in the small intestine and accelerates it in the large intestine [3,4,7]. However, the mechanism of these changes in contractile activity in the stomach and intestine underlying the observed alterations in chyme passage remains unclear. Recently, the nature of stress-induced changes in contractile activity of various GIT subdivisions were studied by tensometry and recording of myoelectric activity (MEA) in awake animals [2,5,6,8]. Our aim was to compare the stress-induced changes in contractile activity of the gastroduodenal and ileocecal zones of GIT.

MATERIALS AND METHODS

Chronic experiments were performed on 6 male rabbits weighing 2.5-3.0 kg. Bipolar loop electrodes were implanted subserously in smooth muscles of the distal ileum, ileocecal valve, and proximal colon (series I), or antral and pyloric portions of the stomach and proximal duodenum (series II). Implantation of electrodes was carried out with assistance of K. A. Shemerovskii, Ph. D.). The experiments were started on days 10-12 after electrode implantation. MEA of the stomach and intestine was recorded using an ERG-16 encephalograph (0.1 sec time constant, 7.5 mm/sec paper velocity, and 250 μV/cm pen sensitivity). After recording of baseline MEA, the rabbit was immobilized in the supine position. This procedure induces a pronounced stress reaction [1] manifested in a drastic increase (by 25%) of the heart rate (HR). Immobilization stress was modeled once per day. Contractile activity was assessed by the frequency of spike bursts (FSB, the number of spike bursts per two minutes). The data were processed statistically using Student's *t* test.

RESULTS

During a 40-min immobilization in the supine position, the mean FSB in the antral portion of the stomach decreased in 8 of 11 experiments (by on average 7%), increased in 2 experiments (by 20%), and remained unchanged in one experiment. In the pylorus, FSB decreased in 6 and increased in 5 of 12 experiments; in one experiment FSB remained unchanged. In the duodenum, stress increased FSB in 11 experiments and decreased it (by 17%) in one experiment. Thus, immobilization considerably decreased FSB in the stomach antrum and increased it in the duodenum (Table 1). In the pylorus, the mean FSB during immobiliza-

Department of Visceral System Physiology, Institute of Experimental Medicine, Russian Academy of Medical Sciences, St. Petersburg

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tion did not significantly differ from the baseline (FSB increase and decrease were equiprobable, Fig. 1, *a-c*).

During the first 20 min of immobilization, the mean iliac FSB decreased in all 6 experiments. In the area of the ileocecal valve, FSB decreased in 4 and increased in 2 experiments (by 29 and 32%). In the large intestine, FSB decreased in 5 cases and increased in one case (by 9%). During the second 20 min of immobilization, the mean FSB in the ileum was below the baseline value in 4 experiments or surpassed it in 2 cases (by 29 and 30%). In the zone of the ileocecal valve, FSB decreased in 4 and increased (by 43 and 81%) in 2 cases. In the large intestine, the mean FSB decreased in all 6 experiments. A characteristic reaction to stress in the ileocecal zone was a pronounced decrease of FSB during the first 20 min of immobilization; on minutes 20-40 this parameter remained decreased, but tended to baseline (Table 2). Figure 2 (*d-f*) illustrates characteristic reactions of the ileum, ileocecal valve, and large intestine to immobilization stress.

These data suggest that inhibition of contractile activity in the distal ileum, ileocecal valve, and proximal colon is the most representative reaction to stress

TABLE 1. Effect of Stress on FSB in Rabbit Gastroduodenal Zone (*M±m*, *n*=11-12)

Zone	Baseline	Immobilization, 40 min	
		abs.	Δ, %
Stomach antrum	5.2±0.4	3.4±0.8**	-35
Pylorus	3.7±0.2	3.6±0.5	-3
Duodenum	17.3±1.6	27.2±2.0*	57

Note. *p<0.001 and **p=0.06 compared to the baseline.

in rabbits. Experiments on rats revealed potentiation of contractile activity in the proximal colon in response to stress [2,8]. At first glance, this discrepancy between our finding and published data could be explained by species-specific difference. However, another study performed on rats demonstrated inhibition of contractile activity in the proximal colon during stress [5], which agrees with our data. The present study shows that the reaction of the gastroduodenal zone to stress is characterized by a pronounced potentiation of contractile activity in the duodenum, its

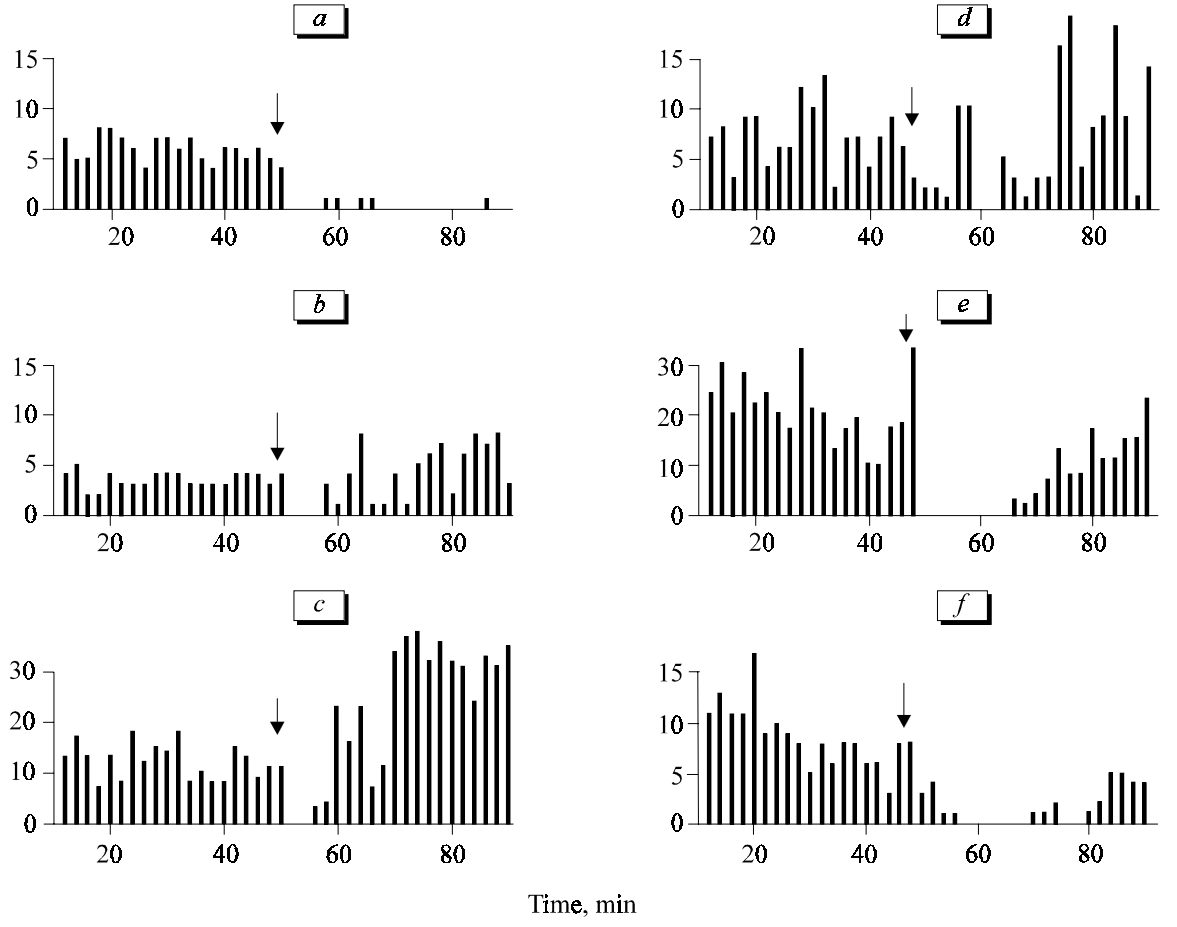

Fig. 1. Effect of stress on frequency of spike bursts in gastroduodenal (*a-c*) and ileocecal (*d-f*) zones of the gastrointestinal tract. *a*) antrum; *b*) pylorus; *c*) duodenum; *d*) ileum; *e*) ileocecal valve; *f*) large intestine. Here and in Fig. 2, arrows indicate the start of immobilization.

TABLE 2. Effect of Stress on FSB in Rabbit Ileocecal Zone ($M\pm m$, n=6)

Zone	Baseline	Immobilization			
		first 20 min		second 20 min	
		abs.	Δ, %	abs.	Δ, %
Ileum	12.5±1.9	5.7±1.9**	-54	10.5±1.5	-16
Ileocecal valve area	14.0±1.0	5.6±1.1*	-60	11.7±2.0	-16
Large intestine	7.3±0.5	2.8±0.6*	-62	4.3±1.1**	-41

Note. *p<0.01 and **p<0.05 compared to the baseline.

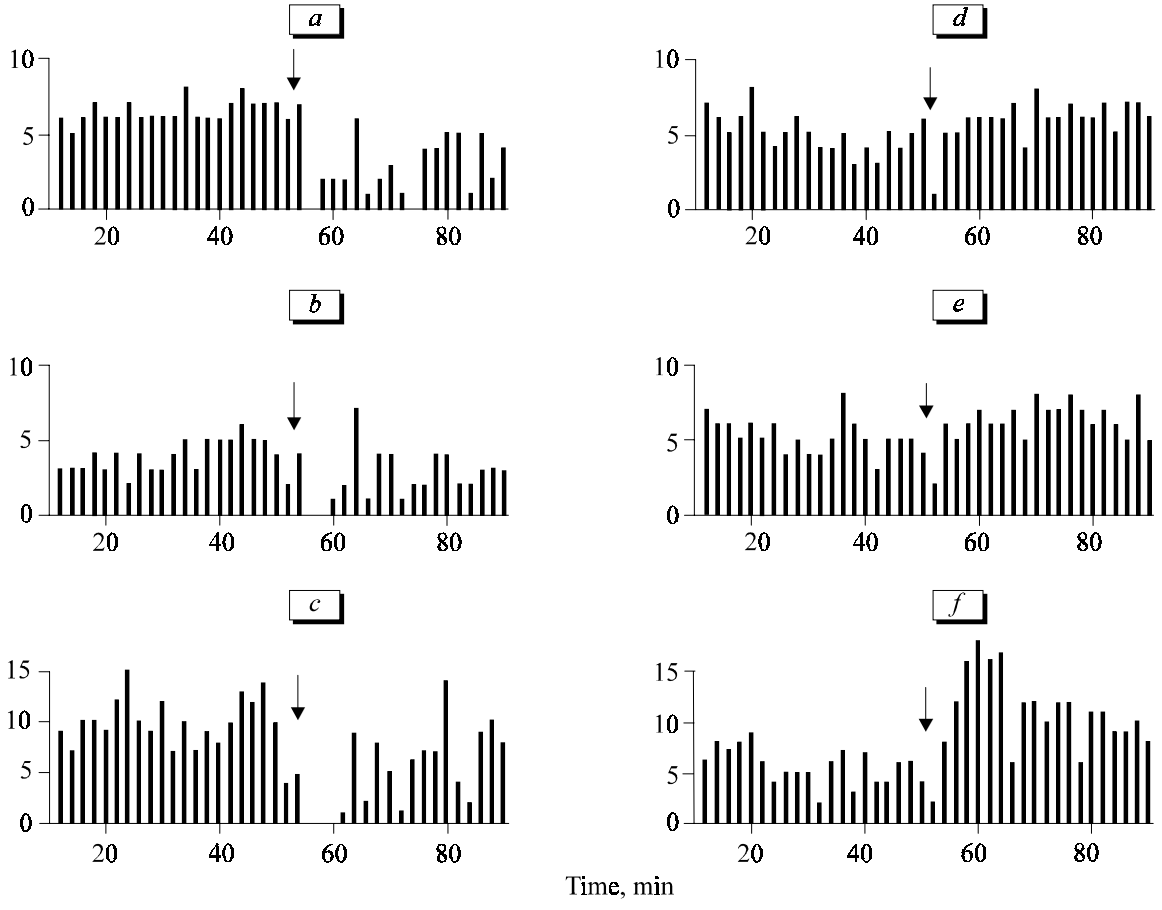

Fig. 2. Frequency of spike bursts in stomach antrum (*a, d*), pylorus (*b, e*) and duodenum (*c, f*) of the same rabbit after the first (*a-c*) and second (*d-f*) stress exposure.

inhibition in the stomach antrum, and dual (ambiguous) response of the pylorus. In dogs stress also increased FSB in the duodenum [6].

Thus, immobilization in the supine position induced different motor reactions in the gastroduodenal and ileocecal zones of GIT in rabbits. Inhibition of contractile activity predominated in the stomach antrum, distal ileum, ileocecal valve area, and proximal colon, and stimulation was observed in the duodenum. In the pyloric zone of the stomach, the potentiation and inhibition of contractile activity were equiprobable.

In the same animal subjected to two stress sessions with a 3-day rest period, the first stress stimulation inhibited contractile activity in the antral and pyloric zones of the stomach and in the duodenum (Fig. 2, *a-c*), while the second stress stimulation induced no inhibitory reactions in the gastroduodenal zone (Fig. 2, *d-f*). Moreover, we observed by potentiation of contractile activity most expressed in the duodenum.

Thus, immobilization stress induces certain changes in contractile activity of different GIT portions, however, opposite reactions can be evoked in the same area of GIT.

REFERENCES

1. S. A. Nikul'shina, K. A. Shemerovskii, and V. I. Ovsyannikov, *Byull. Eksp. Biol. Med.*, **119**, No. 3, 239-242 (1995).
2. M. Gue, A. Tekamp, N. Tabis, *et al., Brain Res.*, **658**, 232-238 (1994).
3. H. J. Lenz, *Gastroenterololy*, **97**, 216-218 (1989).
4. H. Monnikes, B. G. Schmidt, H. E. Raybould, *et al., Am. J. Physiol.*, **262**, G137-G143 (1992).
5. N. S. Morrow and T. Garrick, *Physiol. Behav.*, **62**, 233-239 (1997).
6. M. S. Muelas, P. Ramirez, P. Parrilla, *et al., Br. J. Surg.*, **80**, 479-483 (1993).
7. M. Muraoka, K. Mine, and C. Kubo, *Scand. J. Gastroenterol.*, **33**, 806-810 (1998).
8. R. Stam, G. Croiset, L. M. Akkermans, *et al., Physiol. Behav.*, **65**, 679-684 (1999).