

# THE INFLUENCE OF RADIAL ACCELERATION ON THE SECRETION OF THE INTESTINAL GLANDS IN DOGS

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In previous communications [4, 5] we studied the influence of radial acceleration on the secretion of the salivary and gastric glands. Some difference was found in the duration of the course of the response reaction under these conditions. Whereas unconditioned reflex salivation usually returned to approximately the original value 3-10 minutes after the action of the acceleration, in the case of the gastric glands this period was prolonged to several hours. The cause of this phenomenon was evidently to be found in differences in the regulation of the functions of the organs themselves.

It was thought to be of some interest to study the secretion of the glands of the small intestine, in the regulation of which an important part is played by local nervous mechanisms [1, 2, 3, 6, 7, 8].

## METHOD

Experiments were carried out on four dogs, with loops of intestine fashioned by Thiry's method. In three of these dogs (Seryi, Belaya and Nochka), portions of intestine 25 cm long were resected from the upper division of the small intestine, and in one (Volchikha), from the lower division at a distance of 30-40 cm from the cecum. Intestinal secretion was evoked by the application of a mechanical stimulus (a rubber tube 12 cm long). In addition, in some experiments, observations were made on the periodic secretion of intestinal juice. The experiments lasted 3-6 hours. Besides measuring the volume of secretion, the proportion of solid and liquid portions of the intestinal juice was investigated, and the enzymic activity was determined—amylase, by Wohlgemuth's [9] method, and phosphatase, by the method of L. S. Fomina, S. Ya. Mikhlin and G. K. Shlygin [7].

During the investigations the animals were kept on a constant mixed diet, and before the experiment were starved for 18 hours. Radial acceleration was applied by rotating the animals on a centrifuge of radius 3.6 m. We studied the effect of acceleration in a cranio-caudal direction, of magnitude from 5 to 9 g, and lasting from 20 to 60 seconds. As a preliminary measure, before the experiments to study the effect of radial acceleration, the normal secretion of the intestinal glands was established for a period of 1½-2 months. Altogether 192 experiments were carried out on 4 dogs.

## RESULTS

Immediately after the application of radial acceleration of a magnitude of 5 g and lasting 20 seconds, no special changes could be observed. However, 24 hours after rotation a more than threefold increase in the secretion was observed, by comparison with the initial figures (9.3 ml; Fig. 1).

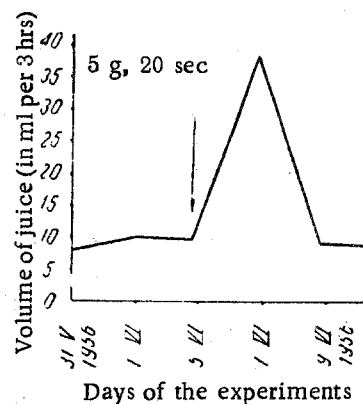


Fig. 1. Change in the secretion of intestinal juice in response to a mechanical stimulus in the dog Volchika under the influence of radial acceleration.

It may be seen from Fig. 1 that the secretion of intestinal juice rose to 38.3 ml 24 hours after the action of the acceleration. On the fourth day it was observed to have returned to its original level. During the period of the effect of acceleration, and also after 2-4 days, the volume of solid residue in the juice was increased.

After the action of radial acceleration of magnitude 7 g for one minute, more prolonged changes were observed in the secretion. Figures obtained in the experiments on the dog Belaya are given in the table.

It can be seen from the table that, on the day of the experiment in which acceleration was applied, a slight decrease in the intestinal secretion was observed. Subsequently the secretion gradually increased and, in the experiment on December 26, i.e., 15 days after rotation, it

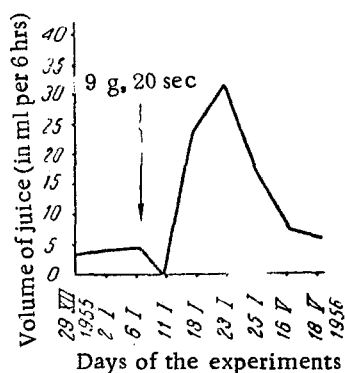


Fig. 2. Change in the periodic secretion of intestinal juice in the dog Nochka under the influence of radial acceleration.

reached 68.6 ml (by comparison with the original values of 21.7-29.6 ml). At the same time the proportion of solid part of the juice increased, and there was a rise in the activity of the enzymes, especially amylase. The activity of the enzyme phosphatase, which rose on the fourth day after rotation, then fell sharply, and in the subsequent experiments no phosphatase was found. We obtained similar results, with the action of acceleration of the same magnitude, in the dog Seryi also. On the 17th day, the secretion had fallen to its original level.

An acceleration of 9 g lasting 20 seconds was followed by much more sharply defined changes. These changes were observed not only during investigation of the intestinal secretion in response to the mechanical stimulus, but also in the state of periodic secretion. As an illustration we show certain findings obtained in the dog Nochka (Fig. 2).

It may be seen from Fig. 2 that the periodic secretion of juice in this dog over a period of 6 hours amounted to 3.2-4.0 ml. No changes were present during the day after the action of acceleration. After 5 days, however, total

disappearance of periodic secretion was observed. On subsequent days the periodic secretion rose sharply. In these experiments the duration of the individual periods was observed to be increased. In several cases the secretion became nearly continuous for an interval of 6 hours. The aftereffect was prolonged.

The effect of radial acceleration is thus to cause considerable changes in the secretory activity of the intestinal glands. After the repeated action of acceleration smaller changes were usually observed, although an increase in the acceleration again led to obvious changes in the secretory activity. As an example, in Fig. 3 are shown the results of experiments carried out on the dog Seryi.

It may be seen that the intestinal secretion after the repeated action of acceleration of 7 g lasting 1 minute was close to the original value. After the application of an acceleration of 8 g for 1 minute, however, an increase in secretion was again observed.

The results described above show that, under the influence of radial acceleration, considerable changes take place in the secretory glands of the intestine in dogs. A very characteristic feature is the duration of the changes observed. Whereas, according to our findings, the after effect on the gastric glands lasts a few hours, that on the secretory activity of the intestinal glands is measured in days, and with high values of acceleration, in weeks.

It must be pointed out that in response to the action of other factors, for example anoxia, on animals a prolonged after effect on the intestinal glands is also observed [6,8]. The cause of such a prolonged after effect evidently lies in the peculiarities of the local nervous reflex regulation of the functions of the small intestine.

While these changes were taking place in the intestinal secretion, the general condition of the dogs remained perfectly satisfactory.

#### SUMMARY

The author studied the effect of positive radial acceleration on the secretion of intestinal juice in dogs. The

TABLE. Influence of Radial Acceleration on the Secretion of Intestinal Juice in the Dog Belaya (Experiment of 1956)

Index	Experimental conditions								
	Background		7 g. 1 min.	Aftereffect					
	Dec. 6	Dec. 8	Dec. 11	Dec. 13	Dec. 15	Dec. 18	Dec. 26	Dec. 28	Dec. 30
Volume of juice secreted in 3 hours in response to a mechanical stimulus (in ml)	21,7	29,6	17,0	21,3	38,1	42,4	68,6	27,4	27,2
Amylase activity	8	8	4	8	32	8	32	16	32
Phosphatase activity	450	200	450	300	750	50	0	0	0
Ratio of solid to liquid parts of the intestinal juice	1:5	1:7	1:5	—	1:2	—	1:5	1:2	1:2

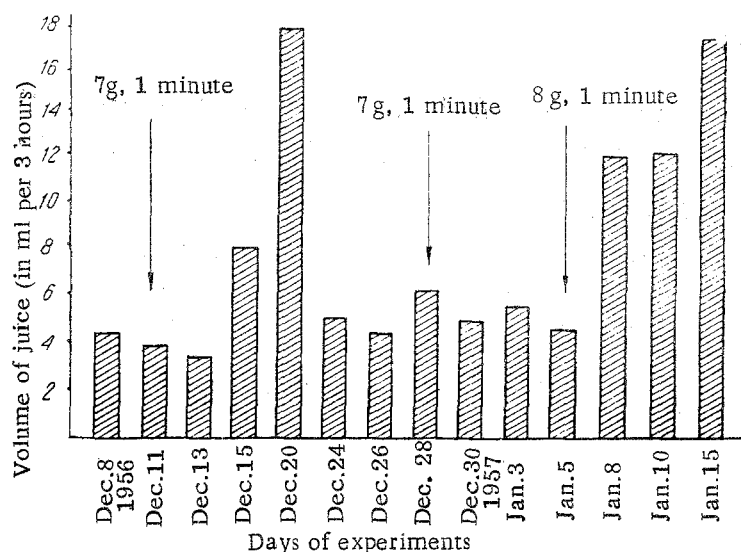


Fig. 3. Effect of repeated radial acceleration on the secretion of intestinal juice produced by application of the mechanical stimulus (the dog Seryi).

first exposure to acceleration was followed by a prolonged after-effect (from several days to several weeks). There was an increase of intestinal secretion, the activity of amylase and phosphatase became changed and a rise in the amount of the solid portion of intestinal juice was noted. In repeated exposure to the action of radial acceleration adaptational phenomena were noted in intestinal secretion.

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