TRIGGER MECHANISMS OF INTESTINAL SECRETION

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One of the causes retarding the study of the secretory function of the intestine was the use until very recently of Thiry and Thiry-Vella intestinal segments completely isolated from the intestine as a whole, and not therefore reflecting its state.

N. V. Maevskaya [4] used an improved isolated segment of the intestine, formed by the Thiry–Pavlov method (in the present author's modification [8]), and found that the act of eating did not stimulate secretion of the liquid part of the intestinal juice. This result was caused by failure to observe two important rules essential in the technique of studying the intestinal secretion.

First, as the results of the author's observation have shown, when an animal is taken for an experiment, an initial period of more intensive secretion by the jejunum is observed, lasting in experiments without drainage for about 1 h, and in experiments with drainage more than 2 h (Fig. 1). The animal must therefore be fed 2-3 h after the beginning of the experiment. Feeding 30 min after, i.e., against the background of the increased activity of the intestinal glands, may in some cases cause depression of the secretion. In addition, the results of experiments involving feeding must be compared with controls at the end of the initial period of increased secretion.

Second, the use of the ordinary drainage tube, the orifice of which is blocked by the intestinal mucus, forced N. V. Maevskaya to withdraw the tube regularly (every 30 min) to free it from mucus. This impermissible manipulation, which disturbed the stability of the intestinal secretion, also distorted the response reaction.

EXPERIMENTAL METHOD

The author studied the regulation of the intestinal secretion of dogs in segments of the jejunum isolated by his modification of the Thiry–Pavlov method, using a system of four drainage tubes which did not obstruct the withdrawal of intestinal juice from the lumen of the bowel. In this way the initial excitability of the intestinal glands could be taken into account and all the stimuli could be applied after the initial period of intensified secretion [9].

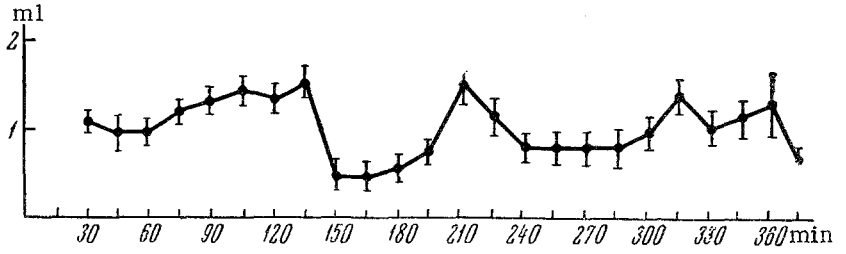

Fig. 1. Periodic secretion of intestinal juice in fasting dogs (mean data).

Secretion of Juice from an Isolated Segment of the Proximal Portion of the Jejunum of Dogs in Experiments with Drainage Tubes

Type of food	Statistical index	Volume of intestinal juice secreted hour by hour (in ml)					
		before feeding			after feeding		
		1	2	3	1	2	3
Bread 200 g	n	4	12	12	12	12	12
	$M \pm m$	3,4±0,7	3,4±0,4	1,9±0,2	4,2±0,4	2,6±0,3	3,8±0,4
	P	—	—		<0,001	—	—
Milk 600 ml	n	—	7	7	7	7	7
	$M \pm m$	—	4,4±0,5	1,5±0,2	2,3±0,3	2,5±0,2	3,9±0.5
	P	—	—		<0,001	—	—
Meat 200 g	n	3	10	10	10	10	9
	$M \pm m$	3,8±0,8	3,8±0,3	2,8±0,4	6,2±0,4	5,4±0,5	5,7±0,5
	P	—	—		<0,001	—	—

Type of food	Statistical index	Volume of intestinal juice secreted hour by hour (in ml)				
		after feeding				
		4	5	6	7	8
Bread 200 g	n	11	10	6	2	2
	$M \pm m$	4,0±0,4	3,6±0,3	2,7±0,1	2,7±0,8	2,6±0,3
	P	—	—	—	—	
Milk 600 ml	n	7	6	3		
	$M \pm m$	4,4±0,4	3,3±0,4	2,6±0,4		
	P	—	—	—		
Meat 200 g	n	8	7	6	2	
	$M \pm m$	5,0±0,6	4,4±0,6	3,7±0,5	2,0±0,4	
	P	—	—	—	—	

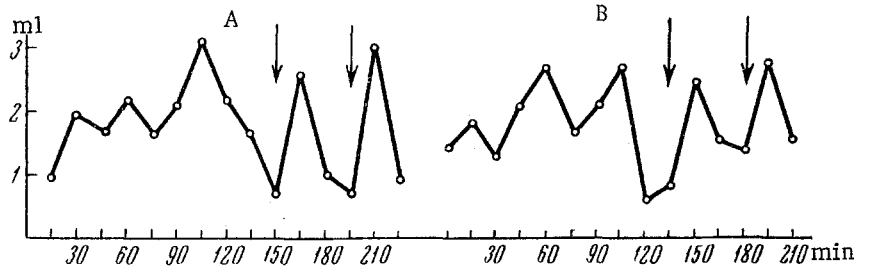

Fig. 2. Conditioned-reflex secretion of intestinal juice in dogs. Arrow—moment of isolated action of conditioned stimulus (bell). A and B) different experiments.

EXPERIMENTAL RESULTS

The experiments showed that the act of taking food causes a statistically significant increase in the rate of secretion from the isolated segment of jejunum (see table). Different types of food caused different changes in the initial and subsequent secretion. When a meat meal was taken, increased secretion of intestinal juice was observed in the first 4 h; in response to bread—in the 1st hour after feeding with a second increase at the 3rd-4th hour. The secretion of juice increased gradually, reaching its highest level at the 4th hour. After several combinations of showing the animal the food and actual feeding, the sight of meat alone caused an increase in the secretion of juice in the 1st and, to a lesser degree, in the 2nd hour, the sight of bread—an increase in the 1st hour, and the sight of milk—a gradual increase in the amount of juice secreted towards the 3rd hour.

This result demonstrates the important role of the cerebral hemispheres in the regulation of intestinal secretion. After six combinations of ringing a bell and giving food, ringing the bell alone led to an increase in the secretion of juice from the isolated segment (Fig. 2). Sham feeding of an esophagectomized dog caused an increase in the secretion of intestinal juice in the first period of 15 min of recording, which continued during the next hour. Division of the right and left vagus nerves stopped the increase in secretion. During stimulation of the peripheral

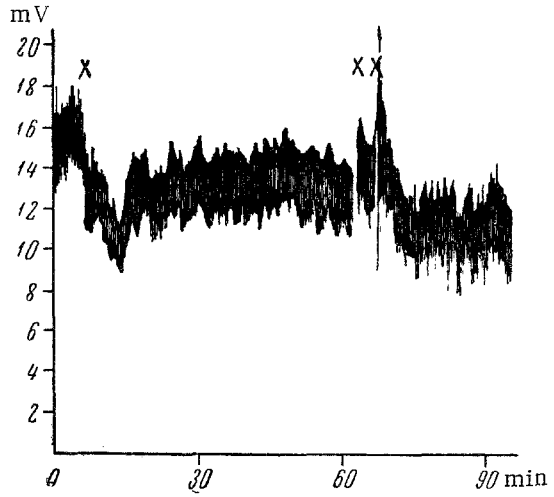

Fig. 3. Electroenterogram. X—sight of food; XX—eating food.

end of the divided vagus nerve in an acute experiment with an induction current, the secretion was increased (the potential of the mucous membrane of the intestine fell), while stimulation of the peripheral end of the splanchnic nerve gave the opposite effect. The excitatory effect of the sight of food and of its actual eating on intestinal secretion was also observed in experiments in which the biopotentials of the mucous membrane of an isolated segment of intestine were recorded (Fig. 3).

Hence the initial trigger mechanisms of the secretion of intestinal juice consisted of conditioned-reflex (cortical) action (the sight and smell of food, the experimental situation, etc.) and the unconditioned-reflex influence of the food through the receptors of the mouth. N. V. Maevskaya's conclusion that "feeding has no significant effect on the secretion of the liquid part of the intestinal juice, and the adequate stimulus for this process is local mechanical stimulation" is the result of the errors of the experimental method described above.

In the present experiments feeding the animals on different types of food (bread, milk, and meat) also gave rise to a statistically significant increase in the amylolytic and proteolytic activity of the juice obtained without a drainage tube [10].

The results of investigations carried out in recent years [1, 2, 5-7] to study the excitatory effect of the taking of food on the secretion of intestinal juice confirm Pavlov's view of the unity of the activity of the whole of the digestive system, including the intestine, and of the decisive importance of the nervous system in digestive processes.

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