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SECRETORY AND EXCRETORY FUNCTIONS OF THE STOMACH AFTER REMOVAL OF THE SUBMANDIBULAR SALIVARY GLANDS

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The problem of functional connections between the salivary glands and organs of the gastrointestinal tract is an important one in modern gastroenterology [8, 11, 15]. There is evidence of changes in the secretory and motor activity of the digestive organs after total sialadenectomy, and also in cases of loss of the mixed saliva and its introduction into the digestive tract [5, 6, 11-14]. It has accordingly been stated that the salivary glands perform a purely digestive function [2, 10] and, through the production of active kallikrein and other biologically active substances, they play a role in the development of working hyperemia of the digestive organs and inhibition of gastric secretion [8, 9].

The object of this investigation was to study the main components of the secretory and excretory functions of the stomach in rats after removal of the submandibular salivary glands.

EXPERIMENTAL METHOD

Experiments were carried out on 103 noninbred albino rats weighing 200-280 g. The fasting secretion of gastric juice was studied by Shay's method [13]. The secretion was collected for 3 h. The secretory and excretory functions of the stomach were studied in parallel tests on 47 control rats and 49 rats on the 7th, 14th, 21st, 28th, and 42nd days after preliminary extirpation of the submandibular salivary glands, and also on eight animals on the 7th day after a mock sialadenectomy. The state of secretion of the glands was assessed from the total volume of the secretion, its proteolytic activity [1], and the absolute hydrogen ion secretion in unit time [3]. To determine the excretory function of the gastric glands the method of gastrochromoscopy was used, with quantitative estimation of neutral red [4]. The dye was injected intravenously as a 1% solution in a dose of 2 mg/kg. To obtain additional data for interpretation of possible changes in the excretory function of the stomach, in parallel experiments the urea and sugar concentrations in the blood and gastric juice of the experimental animals were studied [7]. The numerical results were subjected to statistical analysis by Student's t-test. Differences were considered to be significant at the $P \leq 0.05$ level.

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TABLE 1. Secretory Activity of Rat Stomach after Removal of Submandibular Salivary Glands

Time, days	Output parameters of gastric secretion during 3 h of experiment		
	volume of secretion, ml	hydrogen ion production, mg-ions × 10^{-6}	Pepsin, mg
7	1,30±0,19	1,11±0,51	0,82±0,12
	n=11	n=11	n=11
P	<0,01	>0,5	<0,05
14	1,09±0,25	12,50±5,10	1,26±0,12
	n=14	n=10	n=10
P	<0,05	<0,01	>0,5
21	2,53±0,32	0,98±0,31	1,02±0,24
	n=10	n=10	n=10
P	<0,5	>0,5	<0,5
28	2,94±0,64	14,70±2,00	2,34±0,52
	n=10	n=10	n=10
P	<0,5	<0,05	<0,5
42	1,40±0,17	30,82±11,00	2,15±0,32
	n=8	n=8	n=8
P	<0,01	<0,05	<0,5
Control	3,17±0,58	1,27±0,41	1,54±0,36
	n=36	n=36	n=36

Legend. n) Number of experiments, P) significance of differences from control.

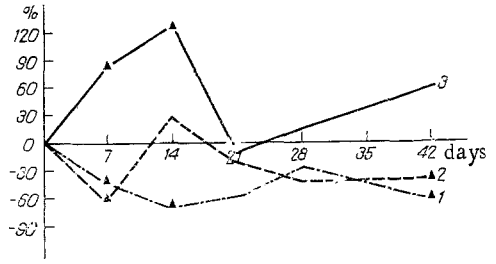

Fig. 1. Dynamics of excretory function of the stomach after removal of submandibular salivary glands in rats. Concentration of 1) urea, 2) sugar, 3) neutral red in gastric juice. Values differing significantly from normal indicated by triangles. Abscissa, time (in days); ordinate, deviation from normal (in %).

EXPERIMENTAL RESULTS

Analysis of results obtained on the animals of the control group showed that fluctuations in the spontaneous values of gastric secretory and excretory activity were not statistically significant. The values for the control groups of rats were therefore pooled and values obtained for the experimental animals were compared with the general control. The experiments showed that 7 days after removal of the submandibular salivary glands changes took place in secretory and excretory functions of the stomach. The volume of secretion was reduced at all times after the operation, but the decrease was significant only on the 7th, 14th, and 42nd days (Table 1). The decrease in the volume of secretion on the 14th, 28th, and 42nd days was accompanied by an increase in the absolute hydrogen ion production, evidence of an increase in the quantity of free acid in the fasting secretion. Changes in the proteolytic activity of the gastric juice were phasic in character. On the 7th day after sialadenectomy the pepsin level was below normal, and later it not only regained the control values, but exceeded them (although not significantly).

Besides changes in the secretory activity of the gastric glands, removal of the submandibular salivary glands also was reflected in the excretory activity of the stomach. Excretion of urea with the gastric juice fell significantly after the operation and was minimal on the 14th day: 0.63 ± 0.15 compared with 1.81 ± 0.38 mg in the control ($P < 0.001$) (Fig. 1). The reduction in the excretion of sugar, however, was significant only on the 7th day: 0.126 ± 0.025 compared with 0.285 ± 0.073 mg in the control ($P < 0.05$). The dynamics of the excretory function of the stomach for neutral red showed a different tendency. During the first 7-14 days elimination of the dye with the gastric juice increased considerably, to 25.98 ± 2.78 and 27.06 ± 1.93 μg, respectively, compared with 15.50 ± 3.89 μg in the control ($P < 0.01$). Later this index not only returned to normal, but actually exceeded it a little on the 42nd day of the investigation.

The results indicate considerable changes in functional capacity of individual components of the gastric mucosa at different times after the operation. These changes, so far as the parietal cells are concerned, are expressed as increased fasting activity, whereas in the chief cells some reduction in fasting activity was observed in the early stages. Regarding the excretory function of the stomach, changes in it depended on the nature of the product. For natural products of excretion, namely urea and sugar, it was reduced, whereas for neutral red it increased. Changes in the excretion of natural products were probably the result of their reduced transport through the gastric mucosa, for as a rule the concentrations of these substances in the blood were unchanged. Experiments on animals undergoing the mock operation showed that all parameters of secretory and excretory functions no longer differed significantly from normal as early as on the 7th day after the operation. This suggests that changes observed in gastric activity after extirpation of the submandibular salivary glands are connected with deprivation of their external and also, possibly, their internal secretory activity. The possibility cannot be ruled out that fluctuations in several indices with time, especially in the late stages after the operation, reflect the activation of compensatory mechanisms, aimed at stabilizing functions at the initial, or at a new, constant level.

Analysis of the results thus suggests that the production of physiologically active substances by the submandibular salivary glands is an additional mechanism of regulation of the secretory and excretory activity of the stomach.

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