FUNCTIONAL AND METABOLIC CHANGES IN THE DIGESTIVE ORGANS IN EXPERIMENTAL DEGENERATION OF THE STOMACH WALL

Yu. K. Vasilenko and M. S. Ivanova

UDC 616.33-007.17-092.9-07:
616.33-008.9-074

Experiments on 98 albino rats showed that as a result of development of toxic-chemical degeneration of the stomach wall after administration of 5% $AgNO_3$ solution seven times over a period of 3 weeks, the evacuatory function of the stomach and its absorption of water were substantially reduced; the absorption of glycine in the small intestine was increased. Meanwhile the amylolytic activity of the contents of the small intestine and of a pancreatic homogenate also was increased. The hypoproteinemia was accompanied by an increase in the total protein concentration in the liver, pancreas, and small intestine.

The character of disturbances and the development of compensatory processes in the digestive system in patients with gastric ulcer has not received adequate study despite the many investigations into the subject of peptic ulceration [7, 9].

It was therefore decided to investigate changes in the parameters of function and metabolism of the digestive organs in experimental degeneration of the gastric wall.

EXPERIMENTAL METHOD

After rats had been deprived of food for 24 h, 8 ml isotonic glycine solution colored with carmine was injected into the stomach through a tube. The animals were decapitated 5 min later. The esophagus and the end of the colored part of the intestine (and in some experiments the proximal portion of the duodenum) were ligated and excised and placed in a vessel kept constantly cold with ice. The length of the stained segment of intestine was measured to provide a measure of the evacuatory power of the gastrointestinal tract (in cm). In some cases the evacuatory power of the stomach (in ml) was determined from the residual volume remaining after introduction of the solution into it.

The contents of the excised portion of the gastrointestinal tract were collected, and the absorptive power of the gastrointestinal tract (as a percentage of the volume introduced) was determined from the difference between the volumes of fluid introduced and collected and the concentration of glycine in it (estimated by formol titration).

The proteolytic activity [5], amylolytic activity [8], and total protein concentration [11] were determined in tissue homogenates and the contents of the stomach and intestine.

The investigation was carried out on 98 albino rats. Tissue from two or three animals was used in each experiment. As the first step the results of production of a gastric ulcer by combined injection of caffeine and arsenious anhydride [4] into the rats, the stressor effect of immobilization [12], and by injection of $AgNO_3$ solution into the stomach [3] were compared in 106 albino rats. In the last case the severest damage to the gastric mucosa was observed. Seven injections (every third day) of 1.5 ml of 5% $AgNO_3$ solution led to the appearance of hemorrhages into the stomach wall, necrosis of the mucosa, and the production of single ulcers in the stomach wall in 65% of cases. No such damage to the wall of the proximal

Experimental Department, Pyatigorsk Institute of Balneology and Physiotherapy. (Presented by Academician of the Academy of Medical Sciences of the USSR N. A. Kraevskii.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 76, No. 11, pp. 47-49, November, 1973. Original article submitted March 15, 1972.

TABLE 1. Functional and Metabolic Changes in the Digestive Organs of Albino Rats with Degeneration of the Stomach Wall

Parameter studied	Intact animals		Animals with degeneration of the gastric mucosa		
	n	*M*	*n*	*M*	*P*
Amount of water absorbed (in % of amount injected)	36	45,3	13	33,4	<0,001
Amount of glycine absorbed (in % of amount injected)	36	34,7	13	39,9	<0,05
Evacuation of glycine solution:					
along gastrointestinal tract (in cm)	8	68,3	11	58,2	>0,1
from stomach (in % of amount injected)	8	69,2	11	54,0	<0,02
Proteolytic activity (in μg tyrosine):					
of gastric homogenate	21	72,9	13	75,3	>0,1
of gastric contents	21	66,5	13	70,7	>0,05
of homogenate of proximal portion of small intestine	21	19,1	13	19,1	1
of homogenate of middle portion of small intestine	21	18,8	13	19,0	>0,5
of homogenate of distal portion of small intestine	21	21,9	13	20,3	>0,1
of contents of small intestine	21	126,0	13	134,2	>0,05
of pancreatic homogenate	21	34,1	13	35,7	>0,5
Amylolytic activity (in mg starch per minute):					
of pancreatic homogenate	13	8405,0	13	13747,0	<0,05
of homogenate of small intestine	13	112,7	13	124,0	>0,5
of contents of small intestine	13	124,6	13	249,0	<0,001
Total protein concentration (in g%):					
in gastric homogenate	29	7,7	12	8,8	>0,05
of homogenate of proximal portion of small intestine	29	5,2	12	6,1	>0,05
of homogenate of middle portion of small intestine	29	4,9	12	6,1	<0,01
of homogenate of distal portion of small intestine	29	4,9	12	5,5	<0,05
of pancreatic homogenate	29	7,2	12	9,0	<0,05
in homogenate of liver	29	8,2	12	10,5	<0,01
in blood serum		6,9—7,6 (Data in literature)	12	3,8	—

segment of the small intestine could be detected by visual examination under fourfold magnification. The defect in the gastric mucosa in 62% of cases persisted for 2 weeks after the injections of $AgNO_3$ were discontinued. In the main section of the investigation the animals were killed on the day after the last injection of $AgNO_3$. Silver, like the other heavy metals, causes coagulation of protein [6], which was evidently responsible for the damage to the gastric mucosa. This limits the usefulness of acute toxic-chemical degeneration of the gastric wall in rats as a model for it is naturally not analogous to peptic ulceration in man. However, since acute gastroduodenal erosions and ulcers are frequent but inadequately studied complications of diseases of the gastrointestinal tract [1], it seemed that this model could be used with advantage to study certain compensatory mechanisms.

EXPERIMENTAL RESULTS

The results are given in Table 1. They show that toxic-chemical degeneration of the stomach wall leads to a marked decrease in the absorption of water (by 26.3%) chiefly on account of a disturbance of its absorption in the stomach. By contrast the absorption of glycine in the gastrointestinal tract was increased (by 14.9%). Meanwhile the motor and evacuatory activity of the gastrointestinal tract was slowed, chiefly on account of inhibition of the passage of the gastric contents into the duodenum (by 21.9%).

The proteolytic activity of the gastric contents and pancreatic tissues was not significantly changed.

In animals with degeneration of the stomach wall the amylolytic activity of the contents of the small intestine was sharply increased (by 99.7%). At the same time it was increased in the pancreatic tissue homogenate (by 63.5%), whereas in the tissue homogenate from the small intestine it showed no significant change. This is contrary to the view [10] that in experimental injuries to the stomach there are no significant changes in pancreatic activity, whereas intestinal functions are appreciably changed to compensate

for the digestive disturbances. It can be postulated from these results that compensation of the digestive disturbances was due primarily to activity of the pancreatic enzymes, whereas the role of the small intestine was evidently limited to resorption and motor and evacuatory activity.

Noteworthy changes are also observed in the protein concentration in the digestive organs, especially the liver (an increase of 28%). These changes can be interpreted as a compensatory reaction to hypoproteinemia arising through the increased liberation of the blood proteins into the lumen of the stomach because of increased permeability of the capillaries in the damaged mucosa [2]. The increase of 25% in the total protein content in the pancreatic tissue homogenate agrees with the intensified enzymic activity observed in the pancreas.

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