

PECULIARITIES OF THE ENZYME SECRETION FUNCTION
OF THE SMALL INTESTINE FOLLOWING RESECTION
OF ITS SUPERIOR OR INFERIOR HALF

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Investigation of the secretory activity of the small intestine following its partial resection is part of a complex investigation being carried out in our laboratory to study the role of different portions of the digestive system in the processes of compensation following exclusion of certain basic functions of the gastro-intestinal tract in dogs.

As we know, the small intestine is an organ basically responsible for the digestion and absorption of food materials. Naturally, removal of one or another of its divisions must be accompanied by reorganization of the remaining portion of the digestive system. Clarification of those changes which occur during this reorganization is a problem that is important both from the theoretical and practical viewpoint.

There is little data in the literature dealing with the effect of removing a portion of the small intestine on the secretory activity of the remaining portion, and what there is bears a basically clinical nature. The experimental works in existence do not elucidate this question to a sufficient degree.

The most factual experimental investigations were carried out as early as 1913, by P. P. Bryukhanov [2] and B. D. Stasov [5]. P. P. Bryukhanov, using polyfistulated dogs, established that resection of the intestine is accompanied by an increase in the output of bile and pancreatic juice. In the opinion of the author, removal of the jejunum was basically compensated for by the large intestine. With resection of the ileum, the compensatory role was fulfilled by the jejunum. In the latter case, an elevation is observed in the enzyme concentration of the pancreatic juice.

B. D. Stasov came to the same conclusions. S. K. Solov'ev [4] noted that if a dog, whose intestine was removed, was given food supplemented with intestinal juice, then its condition improved. On the basis of this, the author concluded that increased secretion of intestinal juice is one of the basic factors in the process of adaptation of the gastro-intestinal tract.

V. P. Mandzhgaladze [3], studying the secretory and enzyme secretion function of the small intestine following resection of 50% of its superior or inferior portion, observed an elevation of the enzyme secretion function, reflected by an increase in the concentration of alkaline phosphatase and enterokinase in the juice obtained from a loop isolated according to the method of Tiri. The isolated loop was taken from the portion of intestine that was resected. More patent changes were obtained with removal of the superior portion of the small intestine.

V. P. Mandzhgaladze only observed these changes in the early intervals following the operation (2-3 months). Later, intestinal derangements appeared, the animals grew thin and died with signs of emaciation. On the basis of the data obtained, the author concluded that shifts in enzyme secretion were compensatory in character.

The data of V. P. Mandzhgaladze requires supplementary investigations, since, in the opinion of many authors, removal of 50% of the small intestine, from any of its portions, does not lead to disruptions in the general condition of dogs.

N. P. Bochkov [1], investigating the morphological changes in the small intestine after its partial resection, did not observe significant changes in the enzymatic activity of the intestinal juice. Elevation of enzyme secretion (alkaline phosphatase) was only observed by the author in the first days after the operation.

It should be pointed out that N. P. Bochkov resected the middle portion of the small intestine, while V. P. Mandzhgaladze removed the superior or inferior segment. It is possible that this partially explains the difference in the results obtained.

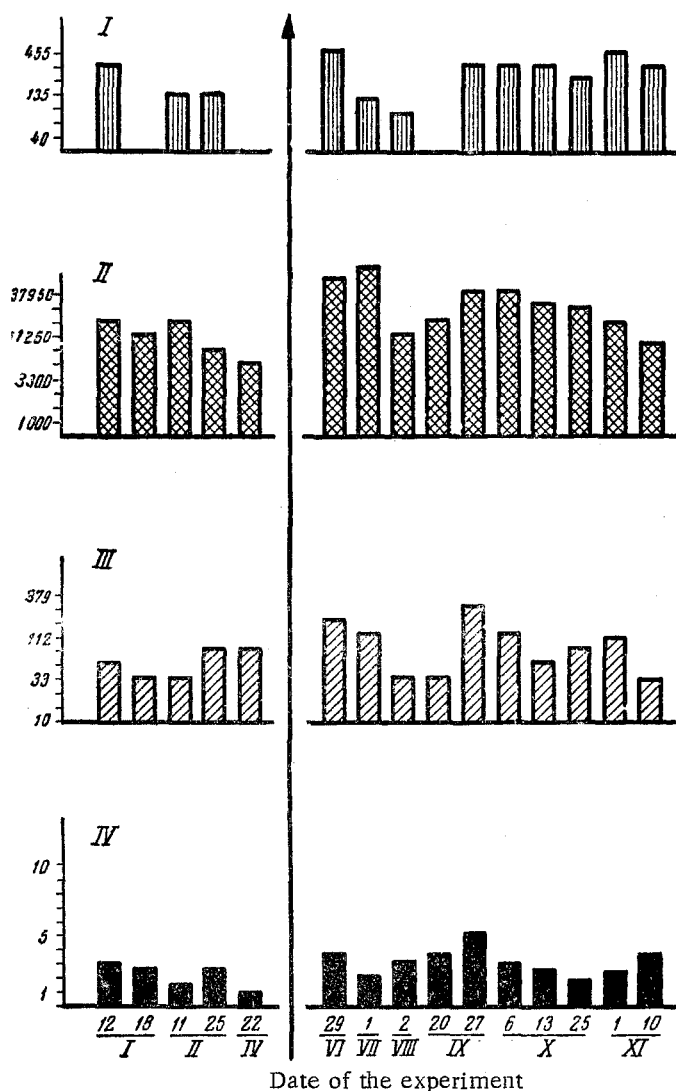


Fig. 1. The amount of intestinal juice (IV) and its concentration of the enzymes enterokinase (I), alkaline phosphatase (II), and amylase (III), in the dog Ozernitsa during periodic secretion. The arrow indicates the time of resection of the small intestine. The arbitrary enzyme units are shown on the vertical. The logarithms of the obtained dilutions are given on the scale.

Thus, on the basis of the data in the literature, it is difficult to consider this question a clear one. For us, its resolution is a necessary link in investigations designed to study the compensatory processes subsequent to exclusion of basic functions of the gastro-intestinal tract. Data obtained in reference to the problem is presented in this report.

EXPERIMENTAL METHOD

The investigations were carried out on 5 dogs, with isolated segments (by the method of Tiri) of the superior (3 dogs) or inferior (2 dogs) divisions of the small intestine. Periodic secretion was studied in a 4 hour experiment, as well as secretion into a 10% solution of peptone, irrigating the isolated loop, which served as an adequate stimulus to the intestine. The basic enzymes (alkaline phosphatase, enterokinase and amylase) were determined in the obtained juice, using the methods developed or refined in the Institute of Nutrition of the Akad. Med. Nauk SSSR [6, 7]. The concentration of the enzymes was expressed in arbitrary units, and calculated per 1 ml of intestinal juice.

After normal intestinal secretion was established, 50% of the superior or inferior half of the small intestine was removed. The investigations were resumed 10-14 days after the operation.

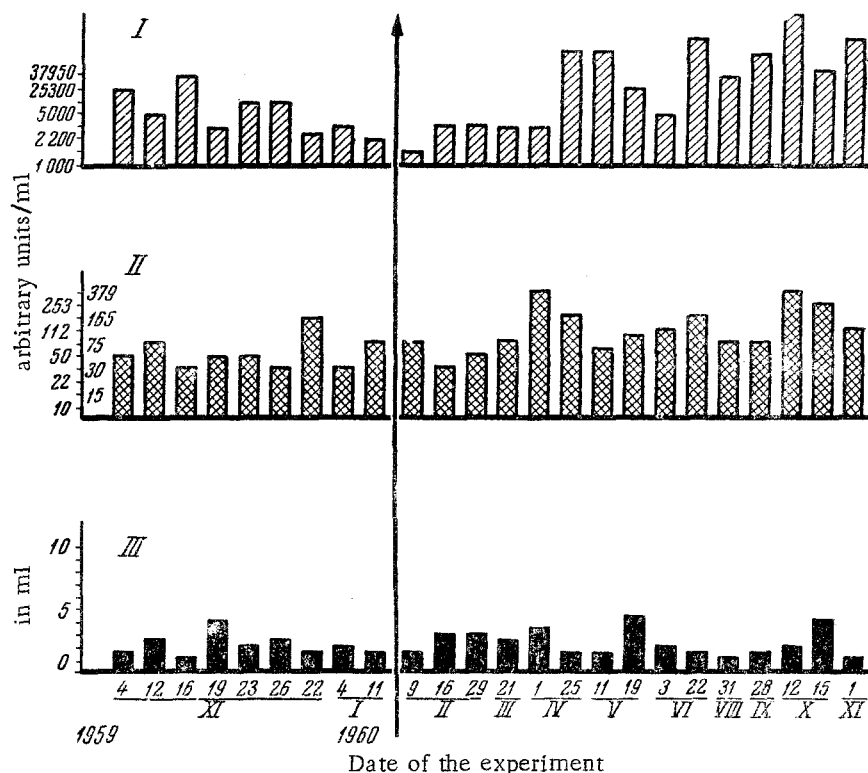


Fig. 2. Amount of intestinal juice (III) and its concentration of alkaline phosphatase (I) and amylase (II) in the dog Tuzika. The arrow indicates the time of resection of the small intestine.

Four variations of the experiment were set up: 1) in the dogs Zhuchka and Ozornitsa, having an isolated loop from the superior portion of the small intestine, we removed the superior segment; 2) in the dog Belka, also having its loop from the superior portion, we removed the inferior half of the small intestine; 3) in the dog Tuzink, having an isolated loop from the inferior portion, we removed the superior half of the intestine; 4) in the dog Pestrushka, having a loop from the inferior portion, we removed the inferior segment of the small intestine.

Thus, it was possible to observe changes occurring in different portions of the small intestine following the removal of its various segments.

EXPERIMENTAL RESULTS

Following removal of half the small intestine, either superior or inferior portion, all the dogs survived for a long period of time (observation period of up to 12 months). No reorganization was observed in the digestive functions.

Investigation of the secretory function in the small intestine following removal of its superior portion was carried out on 3 dogs (Zhuchka, Ozornitsa and Tuzik).

The dog Ozornitsa was kept under observation for 7 months (the investigations continued). After resection of the intestine, a slight increase was noted in the concentration of alkaline phosphatase, both in the juice obtained

during periodic secretion (Fig. 1) and in the juice obtained during irrigation with peptone. The increase in the concentration of alkaline phosphatase was observed throughout the entire course of the investigation. The concentration of enterokinase fluctuated to a lesser degree than prior to the operation, approaching the upper limit of normal. Smaller fluctuations in concentration after the operation were also noted for amylase in the juice obtained from the peptone irrigation. The amount of intestinal juice was somewhat greater than before the operation.

In the dog Zhuchka (observed for 10 months), under analogous conditions, we observed a marked elevation (by ten times or more) in the output of intestinal juice, with some lowering of the concentration of enzymes due to an increase in the fluid portion of the juice. However, the total amount of enzyme secreted with the juice during the experiment was greater than before the operation. The indicated changes were observed both in the juice from periodic secretion and the juice obtained after irrigation with peptone.

In the dog Tuzika we investigated the juice secreted in the isolated loop of the inferior portion of the small intestine. The duration of observations was 12 months. As can be seen from Fig. 2, resection of the superior half of the small intestine also led to minimal changes in enzyme secretion. The concentration of alkaline phosphatase in the juice during periodic secretion increased, beginning with the 4th month after the operation. The alkaline phosphatase activity was also elevated in the juice obtained in response to peptone. Enterokinase was not observed in the juice obtained from the isolated loop of the inferior portion of the small intestine, either before or after the operation. The amount of juice put out after the resection under the given conditions remained unchanged.

Investigation of the secretory function of the small intestine subsequent to removal of its inferior portion was carried out in the dog Belka, with an isolated loop from the superior portion, and in the dog Pestrushka, with an isolated loop from the inferior portion of the small intestine.

In the dog Belka (observed for 7 months) the fluctuation in the concentration of all three enzymes, as well as the amount of juice during periodic secretion, remained within the same limits after the operation as they did before it. The same results were observed in the juice obtained in response to the peptone.

In the dog Pestrushka we also failed to observe any notable changes in secretion and enzyme secretion in response to the removal of 50% of the small intestine from its inferior portion.

Thus, with removal of the superior half of the small intestine in dogs, a slight elevation is observed in the enzyme secretion activity of the intestinal juice produced in an isolated loop. Removal of the inferior half of the small intestine does not cause notable changes. It may be assumed that the changes which we noted following resection of the superior portion of the small intestine are compensatory in character, since the basic treatment of food by the intestinal juice occurs specifically in the upper portion of the small intestine.

SUMMARY

A study was made of the secretory and enzyme-secretory function of the small intestine in dogs following resection of its superior and inferior portions. Periodic secretion and the secretion occurring after the irrigation with a 10% peptone solution were studied.

Three enzymes: enterokinase, alkaline phosphatase and amylase were determined in the intestinal juice obtained from the loops of the small intestine, isolated according to Thiery (in 3 dogs from the superior portion and in 2 others - from the inferior portion). Excision of a half on the small intestine was well tolerated by the dogs. Resection of the lower half of the small intestine caused no changes in the secretion of the intestinal juice, both from the superior and from the inferior isolated loops. Resection of the superior half of the small intestine led to a slight rise in the enzymatic activity of the intestinal juice.

It may be suggested that the changes occurring in the latter case were compensatory by their nature, since it is in the superior portion of the intestine takes place the main treatment of food with intestinal juice.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
