THE EXTERNAL SECRETORY ACTIVITY OF THE PANCREAS AFTER WIDE RESECTION OF THE PROXIMAL DIVISION OF THE SMALL INTESTINE

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The results of investigations by one of us [4] showed that after resection of the distal part of the stomach the secretory activity of its stump and the external secretory activity of the pancreas in response to food stimuli (bread, meat) were considerably diminished. Analysis of these results led us to the conclusion that these organs are not concerned in the mechanism of compensation of the disturbed peptic digestion of the food following this surgical procedure.

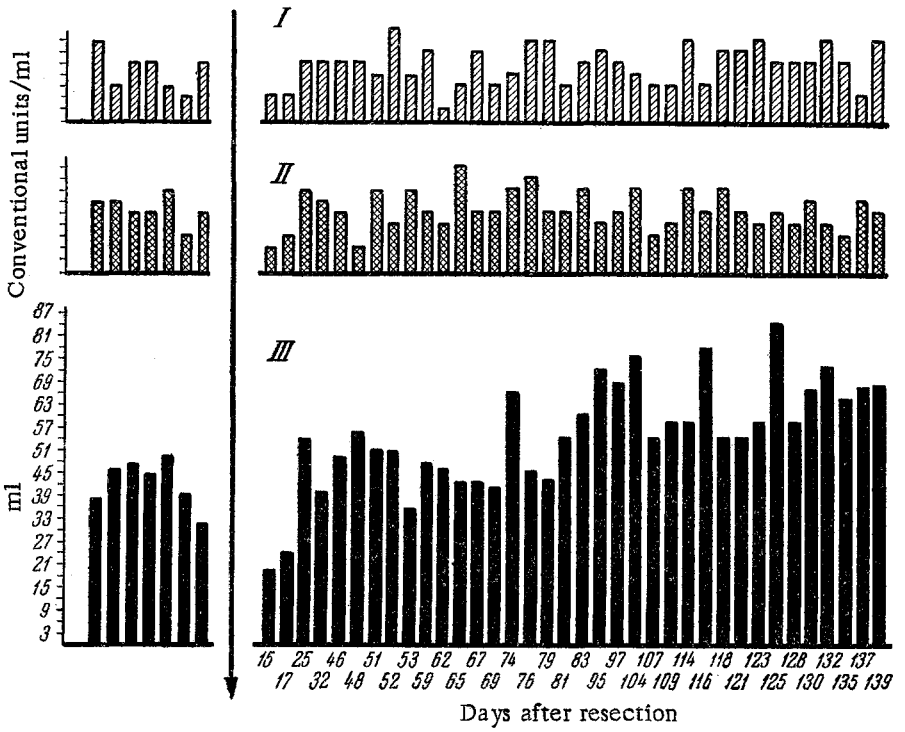

Fig. 1. Volume of pancreatic juice and concentration of amylase and trypsin in this juice in the dog Zita before and after resection of the small intestine. Stimulus—10 g meat. I) Trypsin; II) amylase; III) pancreatic juice. The arrow indicates the moment of resection of the bowel.

The experimental results obtained in our laboratory, in general agreement with those obtained by other workers, together with clinical observations, show that in the conditions described above an important part in the compensatory reactions is played by an increase in the enzymic activity of the intestine.

This led us to consider to what extent the stomach and pancreas take part in the system of compensatory reactions after wide resection of the proximal portion of the small intestine.

Koeberle [6] performed the first successful resection of 205 cm of the small intestine in 1881. Since then considerable research has been done into the problem of extensive resection of the intestine from both clinical and experimental aspects. No unanimity has yet been achieved, however, on several of the more important questions associated with this surgical procedure. While we cannot give a complete analysis of the accumulated evidence, which is admittedly contradictory, and of the problems awaiting solution, we may mention the more important items. One problem remaining unsolved is that of the sequelae of extensive resections of the small intestine, especially as regards the quality of the late results. Discussion continues on which is more essential to the body—the jejunum or the ileum. It must be established whether the stomach takes part in the compensation of the disturbed function of the intestine after partial resection of the latter, and whether the stomach and large intestine can compensate for the loss of a considerable part of the small intestine. We must emphasize that the solution of these problems is not only of theoretical interest, but has an important bearing on practical medicine.

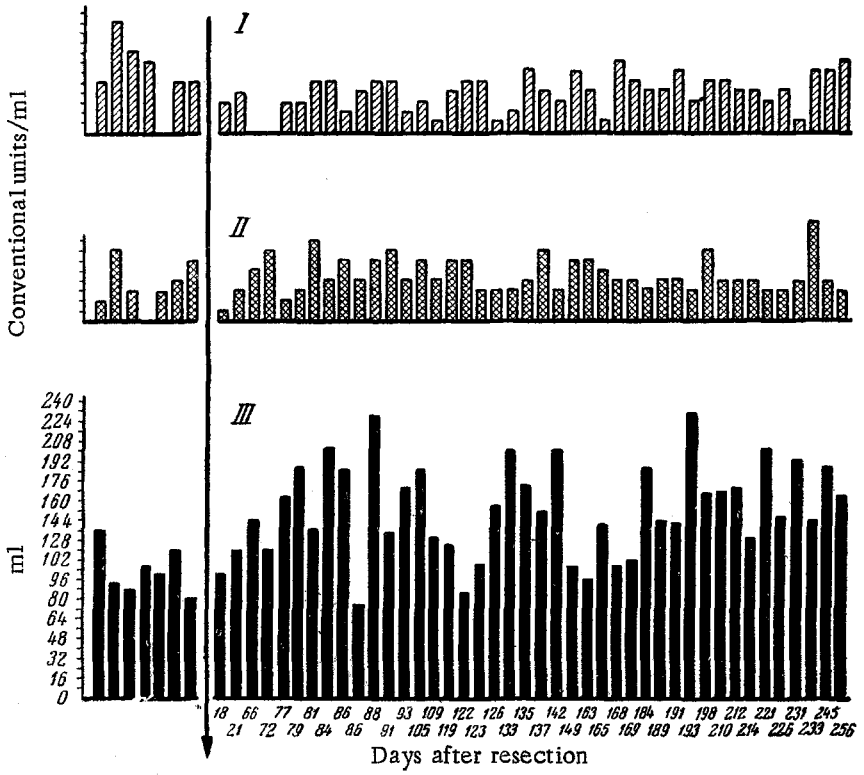

Fig. 2. Volume of pancreatic juice and its amylase and trypsin concentration in the dog Rex before and after resection of the small intestine. Stimulus—100 g meat. I) Trypsin; II) amylase; III) pancreatic juice. The arrow indicates the moment of resection of the intestine.

Our recent investigations on four dogs showed that wide resection of the proximal portion of the small intestine leads to a considerable increase in the secretory activity of the stomach, which evidently should be regarded as one of the links of the functional compensation of the disturbance of digestion associated with this surgical procedure.

The object of this communication is to describe the results of an investigation of the secretory activity of the pancreas in dogs after wide resection of the proximal portion of the small intestine. There are very few reports in

the literature of clinical or experimental investivations of the external secretory activity of the pancreas after resection of the small intestine. According to V. N. Budagovskaya [1], following partial resection of the small intestine in 11 patients the concentration of pancreatic enzymes in the duodenal contents, both before and after administration of hydrochloric acid, lay within the same limits as in healthy persons and in 5 patients the amylase concentration was actually increased. B. D. Stasov [5] and P. P. Bryukhanov [12], in experiments on dogs with multiple fistulae, observed an increased in the secretion of pancreatic juice after resection of the intestine.

EXPERIMENTAL METHOD

The investigations were conducted on 2 dogs with a Bakuradze's fistula an on one dog in which the pancreatic duct had been exteriorized by Pavlov's method. The dogs were kept on a normal diet. The experiments were carried out 18 hours after the last meal. The volume of juice secreted was measured every 15 minutes. Before the stimulus was given, the juice was collected for one hour (the arbitrary secretion, in Dolinskii's words), from which the functional state of the secretory apparatus could be established on each day of the experiment. The normal volume of secretion in response to 100 g meat and 200 ml milk was established. The volume of juice and the concentration of its enzymes (amylase and trypsin) in 1 ml of juice were determined. After these normal indices of secretion had been established, from 65 to 70% (155 to 190 cm) of the proximal portion of the small intestine was resected, to a distance of 5-6 cm from the plica duodeno-jejunalis. Measurements of the length of the resected and remaining parts of the intestine were carried out during the operation, before removal of the bowel. The experiments were performed on the dogs from 2 to 3 weeks after operation. The animals remained under observation for 3 to 10 months.

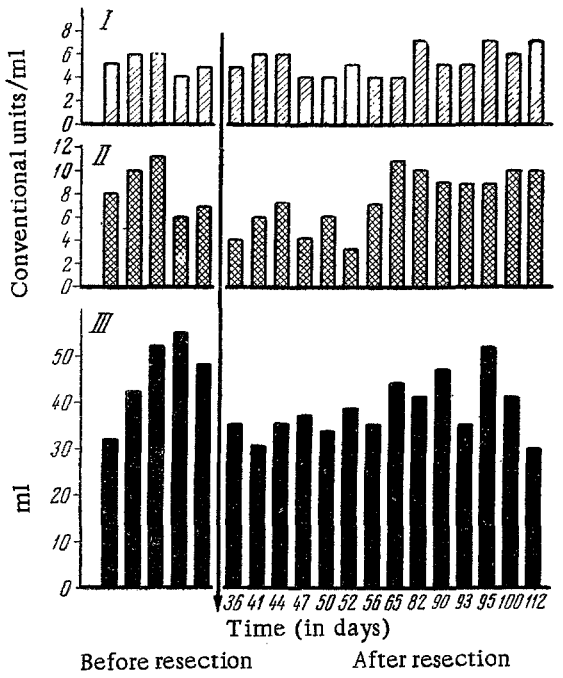

Fig. 3. Volume of pancreatic juice and its amylase (II) and trypsin (I) concentration in the dog Kutsyi before and after resection of the small intestine. The arrow indicates the moment of resection of the intestine.

EXPERIMENTAL RESULTS

The results showed that resection of the proximal portion of the small intestine within the limits defined above led to a considerable increase in the pancreatic secretion in response to meat in all the dogs. It can be seen in Fig. 1 that in the dog Zita, in which the pancreatic duct was exteriorized by Pavlov's method, starting on the 25th day after resection the pancreatic secretion began to increase. During the whole subsequent period of the investigation the secretion remained increased, falling on some days but only to within normal limits. After 3 or 4 months the secretion in response to this particular stimulus became more stable in character and was established at a higher level than before resection.

Equally clear results were obtained in the other dogs. It may be seen in Fig. 2 that in the dog Rex, with a Bakuradze's fistula, the level of the secretion in response to meat fluctuated for more than 2 months within the limits of the initial values, and only after this period was there a comparatively stable increase in the secretion which lasted for several months.

The diagrams show that the concentration of the enzymes amylase and trypsin in 1 ml of juice was almost unchanged, and varied within the limits of the preoperative values. However, because of the increased volume of juice, the total number of units of enzymes naturally increased very considerably.

Our investigations showed that after subtotal resection of the distal part of the stomach, the pancreatic secretion in response to bread and meat fell sharply to an average level of 30-40% of the initial value. The secretion in response to milk, however, not only did not fall but, on the contrary, for a long time (in one dog for about one year) it was raised. Even after more than 2 years, when the secretion in response to other food stimuli amounted to 15-20% of the initial values, the secretion in response to milk was lowered to a much lesser degree, and on some days it remained close to the normal value.

We postulated that as a result of resection of the stomach, much of the milk that was drunk was evacuated rapidly and in an unchanged form. Because of the presence of fat in the milk, it is capable of stimulating the secretion of the pancreas (intestinal phase), along with the acid gastric contents entering the duodenum slowly, a little at a time. From this point of view it might have been expected that as a result of the exclusion of nearly the whole of the jejunum, rich in prosecretion, and also of some degree of delay in the emptying of the stomach because of the extensive resection (as shown by results obtained in our laboratory and by reports in the literature [3]), the secretion in response to milk in contrast to the secretion in response to other stimuli remained within normal limits or showed tendency to fall.

Experiments conducted on 3 dogs showed that in one animal the secretion in response to milk was increased, and in the other two it was decreased. It can be seen in Fig. 3 that the secretion in the dog Kutsyi, with a Bakuradze's fistula, was decreased throughout the period of investigation, and that only on occasional days did it approximate to normal without reaching its upper limit. On the average the secretion was decreased by 15-16%. Similar results were obtained with the dog Zita, with exteriorization of the pancreatic duct by Pavlov's method, although in this case the secretion decreased by 5.4%. So far as the enzyme concentration is concerned, this varied within the limits of the initial values.

In contrast to our observations after resection of the stomach, after wide resection of the intestine the condiction of the animals was perfectly satisfactory. There was no sudden loss of weight, nor could any evidence of dyspepsia, vomiting or diarrhea be observed. Not only was the appetite preserved, but it was actually increased. During the investigation we never noted refusal to eat, as often happened in animals after resection of the stomach, when the dogs either refused to eat altogether or would not accept certain kinds of food, such as meat or bread.

The results show that after extensive resection of the proximal division of the small intestine, the pancreas together with other organs (stomach, residual part of the intestine) plays an active part in compensation of the disturbed digestive function.

SUMMARY

Experimental material presented was obtained on 2 dogs with a fistula according to Bakuradze and on one animal with the pancreatic duct exteriorized according to Pavlov. After the establishment of the normal secretion in response to the main food stimuli (100 gm of meat and 200 ml of milk) the dogs were subjected to an extensive resection (65-70%, 155-190 cm) of the superior portions of the small intestine. As shown, secretion in response to 100 gm of meat was considerably increased in all the 3 dogs; the concentration of the enzymes (amylase and trypsin) per 1 ml of the juice remained almost unchanged, varying within the range of preoperative values. However, the total amount of the enzyme units is markedly increased in connection with the increased amount of the juice. Secretion in response to 200 ml of milk was reduced in 2 dogs and increased in one. The concentration of the enzymes remained within the range of the initial values. The data obtained demonstrated that extensive intestinal resection caused mainly an increased pancreatic juice secretion in response to food stimuli, which could be regarded as a compensatory phenomenon.

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