COMPARATIVE EVALUATION OF THE COMPENSATION FOLLOWING GASTRIC RESECTION BY BILLROTH II AND THE INSERTION METHODS

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The changes in the biochemical indexes ensuing after gastric resection by the insertion method [13, 16] have been inadequately studied. Only two studies [5, 6] indicate the absence of disorders in the protein composition and blood sugar and an increase in the content of enterokinase and phosphatase of the gastric juice after resection by this method. Heretofore, there have been no comprehensive experimental investigations in this direction. We made a comparative study of the shifts in certain biochemical indexes after gastric resection by Billroth II and the insertion method of Kupriyanov and Zakharov under experimental conditions.

METHOD

We investigated six dogs with chronic experimental gastric ulcers that were operated on by the Billroth II method (two dogs) and the insertion method (four dogs). We studied the total protein, protein fractions of the blood serum, the sugar curve after glucose loading (internally), enterokinase and phosphatase of the gastric juice and feces.

Total protein was determined refractometrically, protein fractions by the paper electrophoresis method, and the blood sugar content by Hagedorn and Jensen's method. Enterokinase and phosphatase of the gastric juice and feces were determined by methods elaborated in the laboratory directed by E. K. Shlygin [15, 22, 23]. All investigations were at first carried out on healthy dogs, and then repeated after reproducing in the animals nonhealing gastric ulcers [18]. The results of these investigations were published previously [3]. Resection of 2/3 of the stomach by one of the indicated methods was carried out 2-3 months after creating the gastric ulcer model, and the aforementioned biochemical indexes were studied again for 6-9 months.

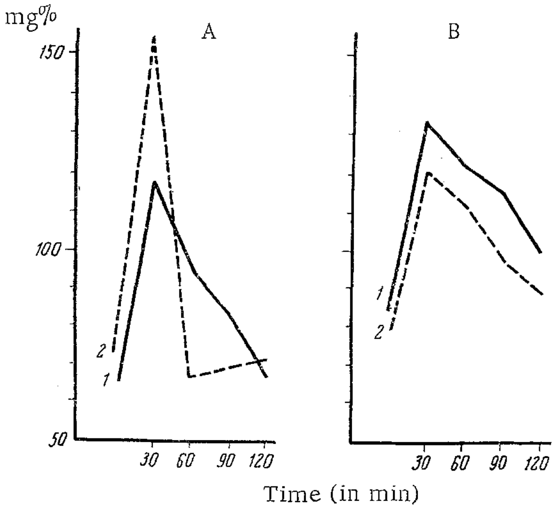

Fig. 1. Changes in the sugar curve after gastric resection by Billroth II (A) and the insertion (B) methods. 1) Control; 2) after gastric resection.

RESULTS

Most authors [7, 8, 12, 25, 27] noted that after gastric resection by the Billroth II method, the type of sugar curve markedly changed: a high elevation of the sugar level was observed 30 min after loading and a pronounced drop after 60 min, wherein the sugar level in the blood drops appreciably lower than the initial level.

In the dogs operated on by the Billroth II method, the type of sugar curve also proved to be altered (Fig. 1A). A pronounced rise of the sugar level was recorded 30 min after loading, and after another 30 min there was a drop below the initial indexes. The hyperglycemic coefficient increased from

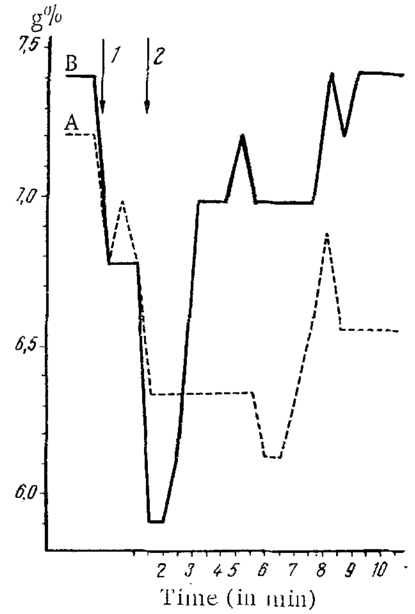

Fig. 2. Changes in the total protein content of blood serum in the presence of a gastric ulcer (arrow with the numeral 1) and after resection (arrow with the numeral 2) carried out by Billroth II (A) and insertion (B) methods.

1.8 to 2.1, the hypoglycemic coefficient dropped from 1.05 to 0.88. After resection by the insertion method, the type of sugar curve did not substantially change (Fig. 1B). The hyperglycemic coefficient before resection was 1.56, after resection 1.53-1.58, and the hypoglycemic coefficient was respectively 1.15 and 1.1-1.2.

Kh. D. Davletbaev [9] demonstrated that the height of the rise of the sugar curve was affected by the quantity of carbohydrates that had passed from the stomach into the intestine. On injection of glucose directly into the upper intestine of a patient known to have a normal sugar curve, a marked rise is observed in the blood sugar level and its rapid drop to hypoglycemic values. A number of authors [4, 19] established that after Billroth II resection in animals, evacuation of food from the stomach stump is accelerated.

A comparison of the changes in sugar curves with the evacuatory function of the gastric stump revealed that a sugar curve with a sharp increase and drop is observed in animals operated by Billroth II method in which acceleration of evacuation from the stomach stump is simultaneously revealed by x-rays. In animals operated by the insertion method, no noticeable acceleration of stomach emptying was noted; no changes in the sugar curve were noted in them.

Many authors [7, 10, 14, 20, 26] point out that hypoproteinemia and hypalbuminemia develop after resection. In the dogs that we studied, the content of total protein after Billroth II resection dropped on the average by 1-1.1 g% in comparison with the level of the control investigations and by 0.5-0.9 g% in comparison with the serum protein level during the ulcerative process. Seven months after resection, the total protein content of the blood serum was 0.43 g% lower than before the operation (Fig. 2).

The drop in the total protein level in the dogs operated on by the insertion method was more appreciable (1.5 g% in comparison with the control and 1.08 g% in comparison with the level in the presence of a gastric ulcer). However, 20 days after the operation, the total serum protein in these animals reached the level that was observed before gastric resection, and the initial level after 1-2 months (see Fig. 2).

In all dogs regardless of the resection method, a 5-6.5% drop in the albumin level relative to the control data was observed for 1-2 months after surgery. After 3-4 months, the albumin level became virtually normal in the dogs operated on by the insertion method. In the Billroth II dogs, the quantity of albumins after a brief rise again dropped, remaining at a low level for the entire subsequent period of the investigations.

The authors who studied protein metabolism after gastric resection explained the mechanism of the observed changes differently. F. F. Dragel', emphasizing that 20-30 g of protein is secreted daily in the stomach, proposes that removal of a large portion of the stomach disrupts this mechanism of maintaining protein balance. Fischer considers that hypalbuminemia arises either as the result of disorders in protein resorption or owing to hepatic function disorders. I. M. Jackson and G. F. Milyushkevich [11] found that, with a loss of the pancreatic juice the quantity of serum protein markedly drops. These disorders are not associated with a loss of proteins and salts in the pancreatic juice, since replacement of these losses does not obviate disease. A rapid restoration of total protein and the protein formula of blood serum in dogs that underwent gastric resection by the insertion method indicates the importance of incorporating the duodenum into the digestive tract for restoring the blood protein level. As the experiments of N. I. Petrushinskii [17] demonstrated, digestion of protein-rich food in dogs proceeds appreciably more favorably when the duodenum is incorporated into the digestive tract than after the Billroth II type operation.

A number of authors [1, 2, 21] found that in animals that underwent resection by the Billroth II method, the secretion of enterokinase with the gastric juice increased. However, there have been no comparative investigations of the dynamics of the enzymes of the gastric juice and feces after gastric resection performed by the Billroth II or the insertion method. Our experiments demonstrated that regardless of the method of operation an increased secretion of enterokinase with the gastric juice was observed in the dogs, which undoubtedly is of a compensatory nature.

But in the dogs operated on by the Billroth II method, an increased excretion of enterokinase with the feces was simultaneously observed. In the dogs operated by the insertion method, a decrease in the quantity of this enzyme in the feces was recorded simultaneously with an increase in the content of enterokinase in the gastric juice.

We consider that this "uneconomical" use of enterokinase by the animals that underwent resection by the Billroth II method is possibly associated with disorders in the function of the large intestine, where this enzyme is broken down and absorbed. The secretion of phosphatase with gastric juice and its excretion with the feces increased in all dogs three to sixfold.

Thus, after gastric resection by the insertion method the functions of the stomach that were lost upon removal of a portion of the organ are compensated better than after resection by the Billroth II method, which is due to the better participation of the duodenum, pancreas, and small intestine in the digestive processes. The rapid normalization of the protein composition of the blood and the negligible changes of the sugar curve indicate that protein and carbohydrate metabolism proceed favorably after this operation.

SUMMARY

Some biochemical indexes were studied in chronic experiments on 6 dogs with a stomach resected after Billroth II (2 dogs) and by the insertion method after Kupriyanov (4 dogs).

Sugar curves in dogs with the stomach resected after Billroth II were characterized by an acute and rapid rise and a similar drop. In dogs operated by the insertion method there were no deviations of the sugar curve from the normal. Blood serum protein composition in dogs operated by this method was normalized 1-2 months after the intervention, whereas in dogs operated after Billroth II no normalization occurred even 7 months after the operation. Enterokinase dynamics of intestinal juice and of the feces studied in both groups of animals demonstrated a more complete digestive utilization of this enzyme following Kupriyanov's operation.

Thus, the insertion method provided better compensation and the latter occurred more rapidly than in the instance of Billroth II operation.

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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.**