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EFFECT OF CHANGES IN THE PH ENVIRONMENT OF THE DUODENUM ON THE EVACUATORY ACTIVITY OF THE GASTRODUODENAL COMPLEX UNDER CONDITIONS OF DISTAL PANCREATIC FLOW

Abstract: In the chronicle experiments on falsetto at dogs are studied pH in duodenum capacity till and during 2 months after transposition of the head canal pancreas irons at the beginning part of their quits. It was concluded that the distal transposition changes pH among the duodenal's capacity and it will call discoordination of the pilorodyodenal reflex, which is influence the speeds and differentiation evacuation from the stomach solutions of sold sours and the sodas in dependence from it reaction (pH).

Key words: duodenum, pH, reflex.

Language: English

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Introduction

According to literature, the motor and evacuation activity of the gastroduodenal complex is regulated with the participation of very complex multiparametric mechanisms. Along with the influence of neuro-humoral and physicochemical factors on the formation of such processes, the regulation is significantly influenced by changes in the pH environment resulting from the secretion of the gastrointestinal tract at different stages of digestion. In addition, in recent years it has become known that a group of enzymes in the pancreatic juice has a regulating (corrective) effect on pancreatic secretion, along with providing hydrolysis of nutrients in the intestine with the participation of their peptide fragments (Коротько et al., 1997; Коротько & Арипов, 2003; Саидбаева, 1983; Solomon, 1994).

It was found that penetration of digestive juice from the pancreas into the duodenum is interrupted experimentally, and the pancreas is transplanted, then there is hypersecretion of the pancreas and inhibition of secretion during intra-duodenal injection (Розин, 1981). The pancreas can inhibit secretion due to feedback mechanisms, which in turn can affect the

secretion of the stomach, as well as its evacuation activity (Арипов & Асханов, 1990; Коротько & Арипов, 2003; Коротько, 2006; Розин, 1981; Сухотерин, 1982).

There is also evidence that with distal transplantation of the main pancreas into the duodenum, that is, with the distal transfer of the pancreas, along with significant changes in the function of the gastrointestinal tract, duodenum and small intestine, significant morphological (structural) changes occur in the mucous membranes (Сухотерин, 1982; Solomon, 1994).

Performing pancreas transplantation by surgery or through the use of other methods and checking the regulatory activity of the gastroduodenal complex become tasks of theoretical and practical importance in the field of modern experimental gastroenterology. In clinical practice, it is possible to predict, determine and use in practice the functional limitations of gastroduodenal complexes concerning their normal physiological states, especially when there is a need to ensure a distal shift of digestive processes or stop the activity of the duodenum and other similar reconstructive operations.

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Literature review

As a continuation of work in this direction, our experimental laboratory studies on dogs are also of interest, and here we are based on the data of our research. Using chronic experiments developed by G.F. Korotko, a method of operating for transplantation of pancreas into the distal part of the intestine, we investigated until now the motor motility and evacuation functions of the stomach, which have not been studied under these conditions. As a result, we found serious changes in these functions of the stomach (Арипов & Асханов, 1990, 1991; Коротько, 2007; Коротько et al., 1989; Коротько & Арипов, 2003).

The dynamics of these changes in each dog were experimentally tested for three months, and the corresponding data were collected. According to the data obtained, in the months following the transplantation of the gland, the rate of evacuation of the alkaline solution from the stomach to the duodenum decreased sharply, while the rate of evacuation of the acid solution increased. In the third month, there was a tendency for the rate of evaporation of alkalinity to approach the normal state; for a long time, high statistical reliability was maintained. In the control experiments carried out, changes of this type were not observed.

It was concluded that the regularity of the evacuation of alkaline and acidic solutions from the stomach into the duodenum or, in other words, the mechanism of the duodenal-pyloric reflex, which depends on the pH of the intestine, was violated. Therefore, we decided to study the changes in the pH environment of the duodenum to determine the causes of these changes.

It is self-evident that the digestive juice of the pancreas penetrates the duodenum due to its alkaline reaction during transportation to the distal part of the proximal duodenum, without affecting the pH environment. In this case, changes in the pH environment of the proximal part can affect the frequency of opening-closing of the pyloric sphincter, duration, pressure gradient, tone, and other parameters that ensure the evacuation process.

Data and methodology

Chronic experiments (120) were carried out on dogs with Basov and duodenal fistulas (Арипов & Асханов, 1991, 1991). To check the speed of pumping various reactive liquids from the stomach into the duodenum, 200 ml of alkaline (0.2% NaHCO₃) and acidic (0.2% HCl) solutions (at 36-37°) were used. During the evacuation, changes in the pH environment of the duodenum were recorded on a millimeter paper tape using an N-338-6P ink recorder (Арипов & Асханов, 1995); standard buffer solutions were used to accurately measure the pH-wave curves (calibration).

During the registration period, alkaline and acidic solutions were injected into the stomach alternately with a fistula within 20 minutes after the end of the active phase of the periodic activity of the stomach, during the resting phase, and experiments were performed daily. After the control (background) data of the dogs were obtained, the main duct of the pancreas (the accessory duct was tied) was transplanted into the 30 cm distal part of the intestine, and ten days after surgery, the above experiments were repeated and continued for more than two months.

We will dwell again on the method of distal pancreatic duct transplantation, which was developed by Korotko. Shortly in our former laboratory, and with the help of which morphological changes in the secretory activity of the stomach, the endocrine apparatus of the duodenum and small intestine were studied (Сухотерин, 1982). We have used this method in our operations. For the analysis of the curves of pH waves, three parameters were taken into account: 1) the number of pH waves every 15 minutes during the evacuation of alkaline and acidic solutions; 2) the duration of the pH waves; 3) amplitude of pH-waves (Δ pH). Using them, information was obtained about changes in the pH environment of the duodenum. If the number of pH waves indicates the frequency of opening of the pyloric sphincter and the rate of passage of a portion of the fluid from the stomach into the duodenum, then the duration and amplitude of pH waves provide data on the necessary criteria on the volume of portions of fluid evacuated from the stomach into the duodenum, their residues in the initial section of the duodenum and neutralization.

Thus, pH waves contain information about the rate and duration of changes in the pH of evacuated solutions in the duodenum; in this case, following changes in the parameters of pH waves, changes in the evacuation activity of the gastroduodenal complex after pancreatic transplantation were analyzed.

Results

The results of our experiment are analyzed by the parameters of pH waves. They show that due to transplantation of the pancreas under normal conditions, the volume of a portion of acidic and alkaline solutions evacuated from the stomach into the duodenum following the regularity of the duodenal-pyloric reflex every 15 minutes decreases.

If, when calculating by the number of pH waves, the frequency of portions of the acid solution entering the intestine is 14-20 portions during the first 15 minutes, then during the last 15 minutes it decreases to 5-8 portions. The frequency of portions of the alkaline solution during the first 15 minutes of evacuation decreased from 7-8 portions to 5-6 portions, their average values were almost the same, which led to a decrease in the differences in acid solution and acceleration of evacuation.

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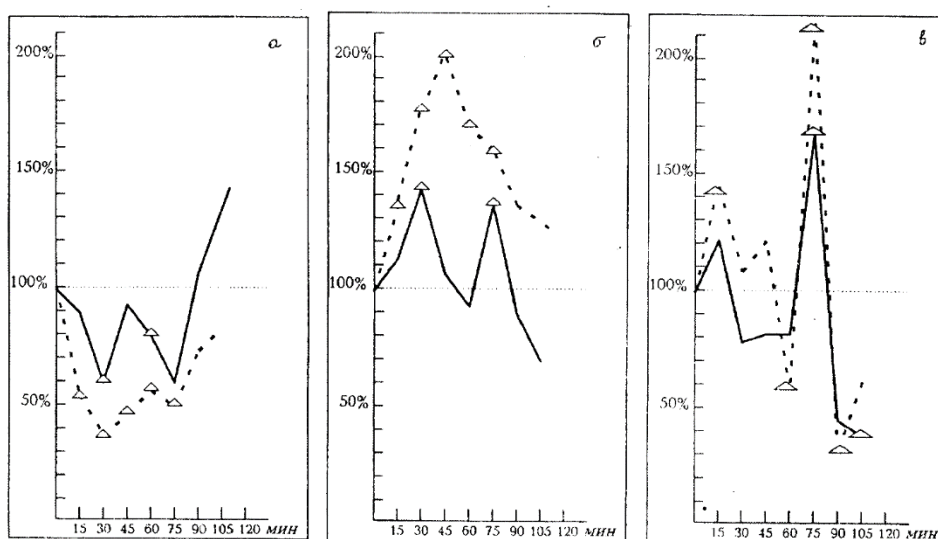
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The duration of the pH waves varied in a different order, that is, they did not decrease during the initial and last 15 minutes of the evacuation period with a slight increase in the acid solution. This can be explained by the fact that the rate of fluid fluctuation in the duodenum remains unchanged or gradually decreases. The fact that the pH wavelength is maintained at a constant rate indicates that the pressure gradient between the stomach and duodenum has a significant impact on the evacuation process.

The amplitude of the pH wave (ΔpH) did not show the same orientation changes during the evacuation of the solutions. However, as a rule, a decrease in the number and duration of pH waves was accompanied by a decrease in ΔpH .

Thus, the main duct of the pancreas was transferred to the distal intestine and the parameters of the pH wave were analyzed. As a result, significant changes were observed in the three parameters of the pH wave. To accurately describe these changes, results obtained from dogs before duct transplantation and results after transplantation of pancreatic ducts: number of pH waves, pH wavelengths, and pH wave amplitude (ΔpH) for every 15 minutes of evacuation period were summarized using Student's t-test, and statistical calculations were performed. In this case, the results of experiments before transplantation of the pancreatic duct were one hundred percent (100%), the results of changes after transplantation of the pancreatic duct were calculated as a percentage. The following graphs are based on these statistics.



Graph 1. Changes in pH waves during the evacuation of an acidic solution (0.2% HCl) observed during the following months after distal pancreatic duct transplantation: a) the number of pH waves; b) duration time of pH waves; c) the amplitude of pH waves (ΔpH)¹

Consider pH waves during the evacuation of an acid solution; curves (graph 1, a, b, c) show that every two months after pancreatic duct transplantation, the number of pH waves decreased during the first 15 minutes. In one of the dogs, this decrease was strongly pronounced, while in the other it was less. In most experiments, an increase in pH waves was observed only during the last 15 minutes of the evacuation. This last change explains the increase in the number of inflows of the solution into the duodenum, which can be considered as one of the reasons for the increase in the rate of evacuation of the acidic solution.

In addition, this problem becomes even clearer when we look at the curvature (graph 1b), which

indicates that the pH wavelengths increase after surgery. Therefore, in our previous experiments, one of the main reasons for the acceleration of the evacuation of acid solution from the stomach was that the months of the postoperative period increased the length of the pH waves, as mentioned above. This is because an increase in the pH wavelengths indicates that the period for which a portion of the acid solution was expelled from the stomach during the evacuation was delayed and that each portion of the solution increased. This is especially evident in the second month after surgery when the statistical accuracy of the pH wavelengths has increased significantly. The state of such changes is explained by changes in the

¹ Note: percentages are on the ordinate, 15-minute evacuation times are on the abscissa; the continuous line indicates the changes during the first month (-----), the dashed line indicates the changes during the second month (- - - -). The points of change with a high degree of accuracy ($p < 0.001$) are indicated on the graph with the symbol Δ .

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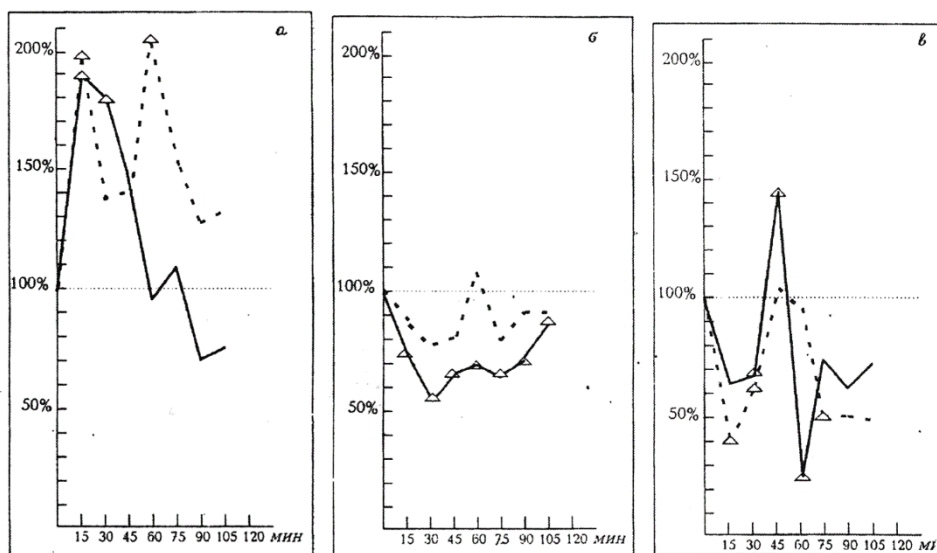
pH-amplitude (Δ pH) of the gradient (graph 1, c), as a rule, due to a decrease in intraduodenal pH. In our experiments, such incidents occurred quickly and to a large extent in the early stages of the evacuation process.

In particular, it should be noted that in all three studied dogs, the change (transformation) of the pH-wave parameters occurred in the same direction.

When we see the evacuation of the alkaline solution, the parameters of the pH waves did not change in the same direction after the gland pathway was transplanted (Figure 2, a, b, c). In the postoperative months, the number of pH waves increased during the initial periods of evacuation and decreased during subsequent periods. The time of pH wavelengths was in the downward direction in the first month after surgery and decreased in the second

month compared to the first month, i.e., the time of rN-wavelengths in the second month was in the direction (trend) approaching its normal state. The amplitude of the pH waves decreases.

Evacuation of the alkaline solution showed that after transplantation of the pancreatic duct, the parameters of the pH wave did not change in one direction (graph 2, a, b, c). In the months following the operation, the number of pH waves increased during the initial period of evacuation but decreased in subsequent periods. The pH wavelength in the first month after surgery tended to decrease, while in the second month it increased relative to the first, which means that in the second month the pH wavelength tended to return to normal. The amplitude of the pH waves decreases.



Graph 2. Changes in pH waves during the evacuation of an alkaline solution (0.2% NaHCO₃) observed in the following months after distal pancreatic duct transplantation²

Conclusion

In conclusion, we can suggest that such changes in the parameters of the pH wave can partially explain the results of our previous experiments, that is, the rate of evacuation of the alkaline solution in the first month after gastric transplantation was reduced, and in the second month, it returned to its normal state. However, we assume that it is advisable to conduct more extensive research in this area. Thus, changes in pH waves in the duodenum after transplantation of the pancreatic duct suggest that the duodenal-pyloric reflex mechanism is severely impaired, and this weakens the rate of acid solution evacuation.

Based on the data obtained, it can be concluded that when the juice secreted by the pancreas is transferred to the distal part of the intestine, this leads to changes in the pH environment inside the duodenum, which affects the frequency of contractions of the pyloric sphincter, the duration of opening and the evacuation activity of the gastroduodenal complex. In general, as a result, the degree of coordination of duodenal-pyloric reflex mechanisms, which coordinate the differentiation of the rate of evacuation, changes to a certain extent.

² a) the number of pH waves; b) duration time of pH waves; c) the amplitude of pH waves (Δ pH). Note: percentages are on the ordinate, 15-minute evacuation times are on the abscissa; the continuous line indicates the changes during the first month (-----), the dotted line indicates changes during the second month (- - - -). The points of change with a high degree of accuracy ($p < 0.001$) are indicated on the graph with the symbol Δ .

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