MOTOR ACTIVITY OF THE DIGESTIVE TRACT IN EXPERIMENTAL RENAL HYPERTENSION AND HYPERCHOLESTEROLEMIA IN DOGS

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The problem of the state of the gastrointestinal tract in hemodynamic disorders is inadequately elucidated in the literature.

It is known from clinical observations [1, 5, 11] that individual hypertensive patients (who had not previously suffered gastrointestinal diseases) complained about dysfunctions of the digestive tract. Changes in the motor function of the digestive apparatus in hypertension and atherosclerosis were mainly studied roentgenologically in persons [4, 7-9, 12] and by means of a graphic recording of contractions by Bykov and Kurtsin's method over a comparatively short period of observation, no more than 1 h [1, 2, 4, 5, 9]. The state of the digestive tract in these diseases has scarcely been investigated experimentally. Only certain authors, for example, B. A. Vartapetov [3], noted an acceleration of the evacuatory function of the digestive tract in dogs with postcastration hypertension. I. L. Chertkov [10] observed an increase in intestinal tonus in acute experiments on rabbits with atherosclerosis.

In disorders of lipoid metabolism and hemodynamic disorders associated with this pathological state, it is important for an analysis of the pathogenesis of atherosclerosis (which is frequently accompanied by hypertension) to study the absorption of certain substances and the motor function of the digestive tract which is intimately associated with this process.

We studied the changes of the fasting periodic activity of the stomach and duodenum in dogs with hypercholesterolemia and renal hypertension.

METHOD

The fasting periodic activity of the stomach and duodenum was recorded in four dogs with Basov's gastric fistulas by the two-balloon recording method. The blood pressure was measured at the carotid artery exposed by a skin flap. After establishing the background of periodic activity of the investigated organs in the dogs Ryzhii and Kashtanka, the renal artery was constricted, first on the right and two weeks later on the left side. Observations were carried out for 1 year after the start of the first constriction against a background of developed hypertension.

After establishing the background of periodic activity of the stomach and duodenum, the dogs Yunets and Druzhok were put on a diet containing daily 30 g of cholesterol, 3 g of methylthiouracil, five drops of vitamin D_2 in order to produce experimental atherosclerosis. The observations were carried out for 4-5 months after the dogs began to be fed cholesterol. All experiments were set up 18-20 h after the last feeding.

RESULTS

The experiments on dogs with experimental hypertension showed that $1\frac{1}{2}$ months after constricting the renal artery, the fasting periodic activity of the stomach and duodenum changed. An increase in the "working" periods, especially the "work" of the duodenum was observed. These changes in motor activity, with a few exceptions,

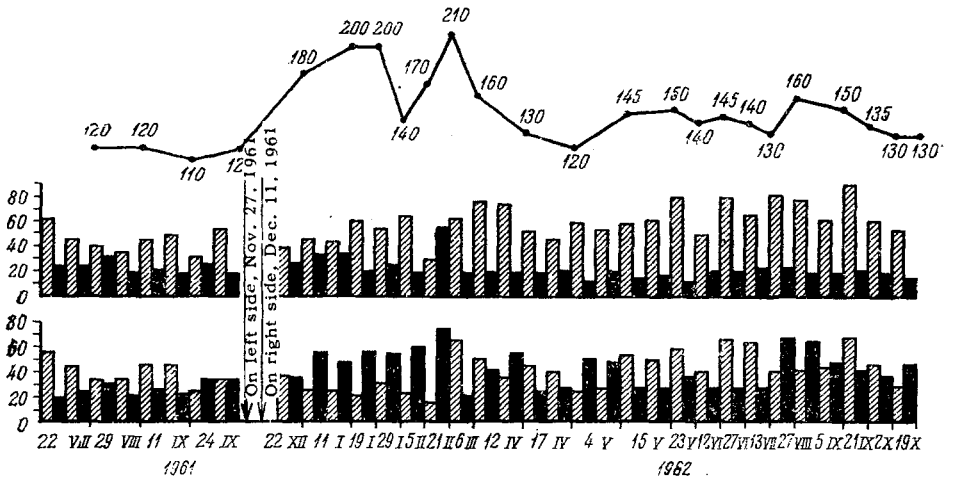

Fig. 1. Changes in the motor activity of the stomach (upper row) and duodenum (lower row) of the dog Kashtanka with renal hypertension. On the ordinate is the time of the "resting" and "working" periods (in min); on the abscissa are the experimental days (parallel recording). The arrows indicate the time of constricting the renal arteries. The solid line above the columns indicates arterial pressure (in mm). The white columns indicates arterial pressure (in mm). The white columns are the "resting" periods; the black columns are the "working" periods.

coincided with the period of a rise in arterial pressure. As we see in Fig. 1, after constriction of the renal artery the arterial pressure of Kashtanka changed pronouncedly: before ligation it averaged 120 mm, and after tying off it rose to 200 mm and held at this level for about 3 months. During this period of time, the "working" periods of the duodenum were prolonged, and the "working" periods of the stomach increased negligibly.

The "resting" periods of the duodenum were shortened, whereas the "resting" periods of the stomach increased in time as the result of the increase in duration of the cycles of the duodenal periodic activity (a cycle is the totality of the "working" period and the "resting" period). On some days of the experiments the periodic activity was disturbed: individual peristaltic waves or entire groups of small diffuse contractions appeared against a background of relative "rest". We need indicate that after ligation of the renal arteries a rapid rise of arterial pressure was at first observed, and the changes in the periodic activity of the stomach and duodenum occurred only 1-1½ months after the first constriction of the renal artery (see Fig. 1, experiment of 11/I, 1962). The rhythmic and peristaltic activity of investigated organs remained unchanged, i.e., corresponded to 16-17 rhythmic contractions per min and 1-2 peristaltic contractions per min, in spite of the appreciable increase of arterial pressure.

Although the arterial pressure dropped over the course of 3 months to 135-140 mm, it did not reach the initial level during the course of 4-5 months. During this time the "working" periods of the duodenum remained high in contrast to the stomach, whose "working" periods were within the norm.

After 8 months the arterial pressure again increased from 140-130 to 150-160 mm, and at the same time the "working" periods of the periodic activity of the duodenum increased.

Similar results were obtained for the dog Ryzhii.

Thus, our investigations demonstrate that constriction of the renal arteries induced changes in the arterial pressure, the level of which for 1 year changed spasmodically, first approaching the norm, then again increasing. Corresponding to this, shifts were noted in the motor activity of the digestive apparatus, especially the duodenum.

The experiments with experimental hypercholesterolemia demonstrated that after the dogs were changed to a diet including cholesterol, the arterial pressure of the dogs somewhat increased. We see in Fig. 2 that in Druzhka the arterial pressure before cholesterol feeding was within 120 -130 mm, and after cholesterol feeding it increased to 140 mm. According to the data of our laboratory (L. A. Shekun), an increase in the level in blood cholesterol was noted in the dogs on this diet. Before changing over to the experimental diet, the blood cholesterol in Yunets

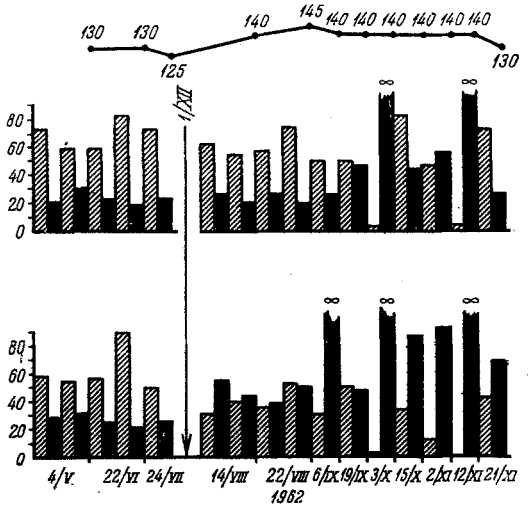

Fig. 2. Changes in the motor activity of the stomach (upper row) and duodenum (lower row) of the dog Druzhka with experimental hypercholesterolemia. The arrow indicates change to a cholesterol diet. The other designations are the same as in Fig. 1.

was at the 170-180 mg% level, and a week after changing to the cholesterol diet the blood cholesterol level reached 420 mg % with a subsequent rise to 750 mg%. The blood cholesterol level of Druzhka before going on the diet was 100-250 mg%, and increased to 800 mg% after changing to the cholesterol diet. After only 1-2 weeks the "working" periods of the dogs with hypercholesterolemia increased in time, and the "resting" periods were shortened. As we see from Fig. 2, at first disorders in the periodic activity of the duodenum were noted, and later, after 1-1½ months, changes in the "working" periods of the stomach ensued. By this time the fasting periodic activity of the stomach and duodenum was markedly disturbed, and continuous contractions developed. During the period on the cholesterol diet, the rhythmic and peristaltic activity of the organs remained unchanged.

Thus, in experimental hypertension the periodic motor activity of the digestive tract changes 1-1½ months after constricting the renal arteries: prolonged "working" periods, especially of the duodenum, appear and the relationship of the "resting" and "working" periods changed. After the dogs were on a cholesterol diet, the arterial pressure increased negligibly, and changes in the periodic activity developed 1-1½ months after the animals changed to the special diet. The rhythmic and peristaltic activity of the investigated organs in both cases remained unchanged.

The persistence of the rhythmic activity of the studied portions of the digestive tract permit the assumption that in this case the excitability of the intramural nervous system changes less than that of the extramural system, which mainly controls motor periodicity.

SUMMARY

A disturbance of fasting periodic activity was noted in the stomach and duodenum of 2 dogs with experimental renal hypertension and 2 animals with alimentary hypercholesterolemia. This disturbance was mainly manifested in prolonged duration of the "working" period, especially of the duodenum. Rhythmic and peristaltic activity of the organs investigated remained unchanged in the mentioned pathological conditions. Preservation of the rhythmic activity leads to a supposition that in the given case excitability of the intramural nervous system changes to a lesser degree than that of the extramural system mainly controlling the motor periodicity.

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