ON THE REFLEX INFLUENCES OF THE DIGESTIVE TRACT ON ITS ABSORPTIVE CAPACITY UNDER NORMAL CONDITIONS AND IN ASSOCIATION WITH LIVER PATHOLOGY

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 54, No. 9,
pp. 50-53, September, 1962

To date, the cortical mechanism of regulating the metabolism in the organism has been proven, the complex reflex nature of this process has been established, and the importance of the functional state of the nervous system in the processes of glandular tissue permeability has been demonstrated. There is also considerable evidence in the literature showing that influencing actions on the receptors of the various organs, from one or another route, cause changes in the pathway of the metabolic processes [1, 2, 5-17].

Up until the present, the majority of investigators, in studying the absorptive functioning of the digestive tract, used the isolated intestinal loop, following the method of Tira.

The question of how the absorptive capacity of the entire, intact digestive tract changes when various actions are exerted on the functioning of the nervous system remains inadequately studied. Particularly little work has been devoted to the change in the absorptive functioning of the digestive tract associated with liver pathology. Earlier, we reported the results of certain investigations on this question [4, 7].

We studied the effect of mechanical stimulation of the stomach and simulated feeding of the animals on the rate of absorption of radioactive sodium phosphate (P^{32}) from the digestive tract, and on the rate of its utilization (disappearance from the blood) in healthy dogs. Similar experiments with mechanical stimulation of the stomach were carried out on dogs with parenchymatous hepatitis.

EXPERIMENTAL METHOD

Mechanical stimulation of the stomach was carried out by the widely accepted method over a period of 2 hours (balloon volume of 300-400 ml), after which the balloon was removed, the gastric fistula was closed, and the dog was given milk containing P^{32} to drink.

Simulated feeding with meat was carried out for 5-15 minutes at different intervals after the introduction of P^{32} into the stomach via a sound (quickly after the administration of the P^{32}, and after 180, 240, 300 and 360 minutes).

The total and inorganic phosphorus was determined in the blood serum, as well as its radioactivity, and the specific activity of the blood was calculated according to the method described earlier [5]. The usual duration of the experiment was 4-8 hours.

With administration of P^{32} orally, two factors influenced the character of the curves for the specific activity of the blood sera—the rate of P^{32} absorption and the rate of its utilization in the organism. In order to study separately the effect of simulated feeding or mechanical stimulation of the stomach on phosphorous metabolism in the organism, we turned to the following experimental setup. As was reported earlier, the specific activities of the total and inorganic phosphorous in the blood serum, one day or more after administration of the P^{32}, were at relatively constant levels, decreasing gradually from day to day. We took this relatively constant level of the serum specific activities as the background amplitude, on top of which we carried out the mechanical stimulation of the stomach or the simulated feeding of the animals. We first drew 3-4 samples of blood when the animals' stomachs were empty, at intervals of 30 minutes; we then carried out the simulated feeding or the modified simulated feeding with meat, over a course of 5-15 minutes. After 5-15 minutes, we again drew some blood. Subsequently, blood samplings were repeated after every 30 minutes for a period of 2-2½ hours.

Similar experiments were performed with mechanical stimulation of the stomach: blood was taken before the mechanical stimulation, during the period of stimulation (over a course of 2 hours), and then in the succeeding two hours.

In order to elucidate the effect of mechanical stimulation of the stomach on the absorptive functioning of the digestive tract associated with liver pathology, we used dogs in which hepatitis was induced by traumatization with carbon tetrachloride, or dogs with a gall bladder fistula, in which hepatitis had arisen secondarily to infection from the biliary ducts, the constant trauma to the walls of the gall bladder by the fistula, and other reasons. Histological investigations of the liver in this group of dogs, as performed by E. A. Rudik-Gnutova, showed the presence of parenchymatous hepatitis.

The experiments with mechanical and simulated feeding were performed on 3 healthy dogs and 4 with pathological alterations in the liver; a total of 30 experiments were set up.

EXPERIMENTAL RESULTS

Mechanical stimulation of the stomach slowed the rate of P^{32} absorption from the digestive tract, and the maximum specific activity of the blood shifted to the right (Fig. 1). Simulated feeding with meat, performed quickly

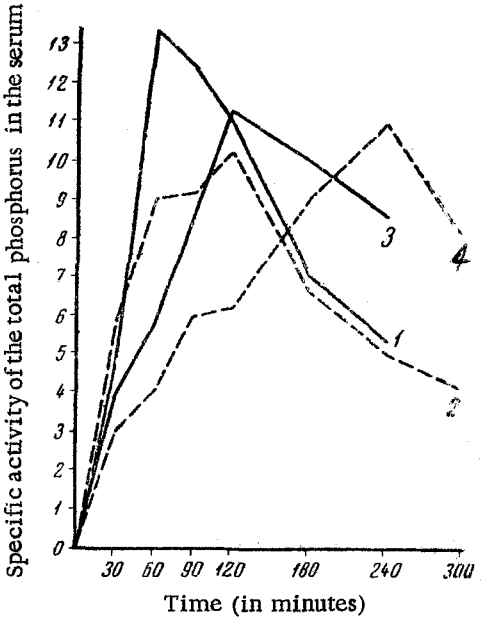

Fig. 1. The effect of mechanical stimulation of the stomach on the rate of absorption and utilization of P^{32}. 1 – background experiment (the dog Volchok, with a gastric fistula); 2 – the experiment with administration of P^{32}; 3 and 4 – comparable experiments on the dog Tsyganka.

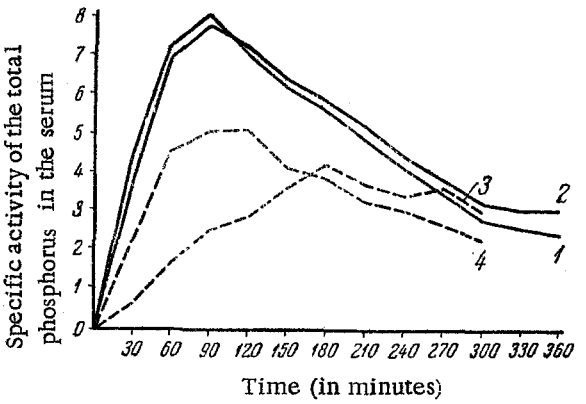

Fig. 2. The rate of absorption and utilization of P^{32} in the gastroesophagotomized dog, Dunaya, before (1, 2) and after (3, 4) simulated feeding.

after the administration of P^{32}, decreased the rate of P^{32} absorption to an even greater degree (Fig. 2). Simulated feeding with meat at later periods after the P^{32} administration (after 180 and 240 minutes), when the process of P^{32} absorption is essentially finished, did not cause changes in the character of the specific activities of the blood. Simulated feeding with meat and mechanical stimulation of the stomach, performed in the setting of a relatively stable specific activity of the blood, also did not cause changes in the character of the blood specific activities, within the ratio P^{32}/P^{31}. Analogous results were also obtained with the modified simulated feeding with meat.

Earlier, we showed that in dogs with parenchymatous hepatitis, the rate of P^{32} absorption and its utilization in the organism are decreased [5]. With mechanical stimulation of the stomach in dogs with the hepatitis, the level of radioactivity in the blood during the first period (in the course of 90 minutes after administration of the P^{32}) fell within the range of that of the background experiments or was slightly higher. In the subsequent period of time (90-240 minutes) we observed a higher level of blood radioactivity in comparison with the background experiments on the same dogs (Fig. 3). Obviously, with mechanical stimulation of the stomach in dogs with hepatitis, phosphate utilization in the organism is distributed to a considerable degree.

Thus, simulated feeding of the animals and mechanical stimulation of the stomach slows the absorption of P^{32} from the digestive tract. A number of factors obviously lie at the root of this process. It is known that with mechanical stimulation of the stomach the appearance of acid gastric juice is possible [9, 17]. Simulated feeding causes copious gastric secretion. A change in the acidity of the gastric contents, in turn, leads to a change in the evacuatory-motor functioning of the stomach, which causes retention of food material in the stomach, thus manifesting an influence on the rate of P^{32} entrance into the digestive tract, and on the character of its utilization in the organism. Changes in the functional state of the vegatative nervous system associated with mechanical stimulation or simulated feeding of the animals doubtlessly also exert an effect on the functioning of the circulatory system, on the permeability of the intestinal mucosa, and thus, on the intensity of absorption of one or another substance from the digestive tract.

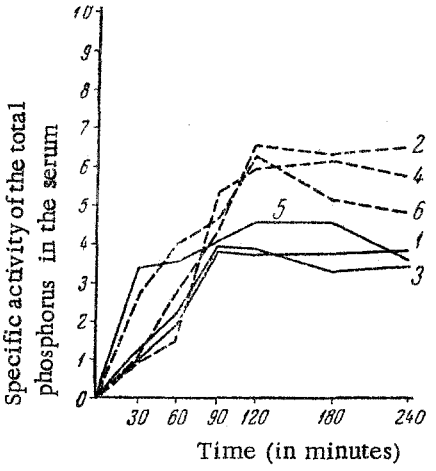

Fig. 3. The effect of mechanical stimulation of the stomach on the rate of absorption and utilization of P^{32} in association with liver pathology. 1 and 2 – in the dog, Kroshka, before and after mechanical stimulation of the stomach; 3 and 4 – analogous experiments on the dog, Belka; 5 and 6 – on the dog, Igraya.

In healthy dogs the simulated feeding and mechanical stimulation of the stomach do not exert an effect on the process of utilization of inorganic sodium phosphate by the organs and tissues. Obviously, in healthy dogs these actions are just adequate stimuli, and do not lead to profound changes in the phosphate metabolism within the liver and other tissues.

With liver pathology, involving disruption of its structure and including neural elements, mechanical stimulation of the stomach leads to a change in the phosphorous metabolism, resulting in a slower disappearance of the P^{32} from the blood.

SUMMARY

A study was made of the effect of mechanical stimulation of the stomach on the rate of $Na_2HP^{32}O_4$ absorption from the digestive tract and the rate of its utilization (disappearance from the blood) in unaffected dogs and those suffering from parenchymatous hepatitis. Analogous investigations were conducted on healthy dogs in conditions of sham feeding. As demonstrated, sham feeding of healthy animals and mechanical stimulation of the stomach do not effect the radiophosphorus absorption, which is evidently connected with the changes of the evacuatory-motor function of the digestive tract. At the same time sham feeding and mechanical stimulation of the stomach have no effect on the inorganic phosphorus utilization from the blood. In affections of the liver the same mechanical stimulation causes considerable changes in the phosphorus metabolism.

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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.
