THE INFLUENCE OF RESECTION OF TWO-THIRDS OF THE STOMACH UPON THE RESORPTION OF SODIUM PHOSPHATE (P^{32}) FROM THE DIGESTIVE TRACT AND ITS UTILIZATION IN THE ANIMAL BODY

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(Presented by Academician V. N. Chernigovskii)
Translated from Byulleten' Éksperimental' noi Biologii i Meditsiny, Vol. 51, No. 5, pp. 48-52, May, 1961
Original article submitted January 13, 1960

In an earlier publication [2] we were able to show that disorders of the resorption of breakdown products of casein labelled with I^{131} and methionine labelled with S^{35} in the digestive tract can be observed in dogs after resection of the stomach according to Billroth II in the modification of Finsterer. These changes were due to disorders of the evacuatory function of the stomach stump.

After the resection of the stomach the resorption shows changes immediately after as well as at later periods after the operation. The observation was continued for a period between one and 16 months after the operation.

With the aid of radioactive sodium phosphate (P^{32}) used as indicator we collected an extensive experimental material which characterized the resorption capacity of the digestive tract in various functional states: during the stimulation of the n. vagus and the receptor zone of the stomach; during blockage of the vegetative nervous system with atropine, after transsection of the n. vagus, in anemia, caused by denervation of the fundus and corpus and under other conditions [2, 3, 4]. A fact established by us in an earlier investigation: changes in the resorption of phosphate from the intestine and in its utilization in the body in pathological conditions of the liver ought to be particularly emphasized.

There are reports in the literature according to which stomach resection creates conditions for the development of a pathological process in the liver. In view of this fact, we found it necessary to study on one and the same animal at various periods after the stomach resection the resorption of phosphate from the intestine and to compare the changes found with those changes which had been found by us in cases of hepatitis.

The present investigation was carried out simultaneously with the investigations concerning the resorption of breakdown products of casein labelled with I^{131} and methionine labelled with S^{35} on the same dogs [5].

METHODS OF EXPERIMENTS

Seven dogs were used for the experiments. In five of them stomach resection by the method of Billroth II in the modification of Finsterer was carried out. The rate of resorption of sodium phosphate ($Na_2 HP^{32}O_4$) and its utilization in the animal body were initially studied in control experiment before the resection of two-thirds of the stomach and then at various periods after the operation. The longest period of observation lasted 16 months.

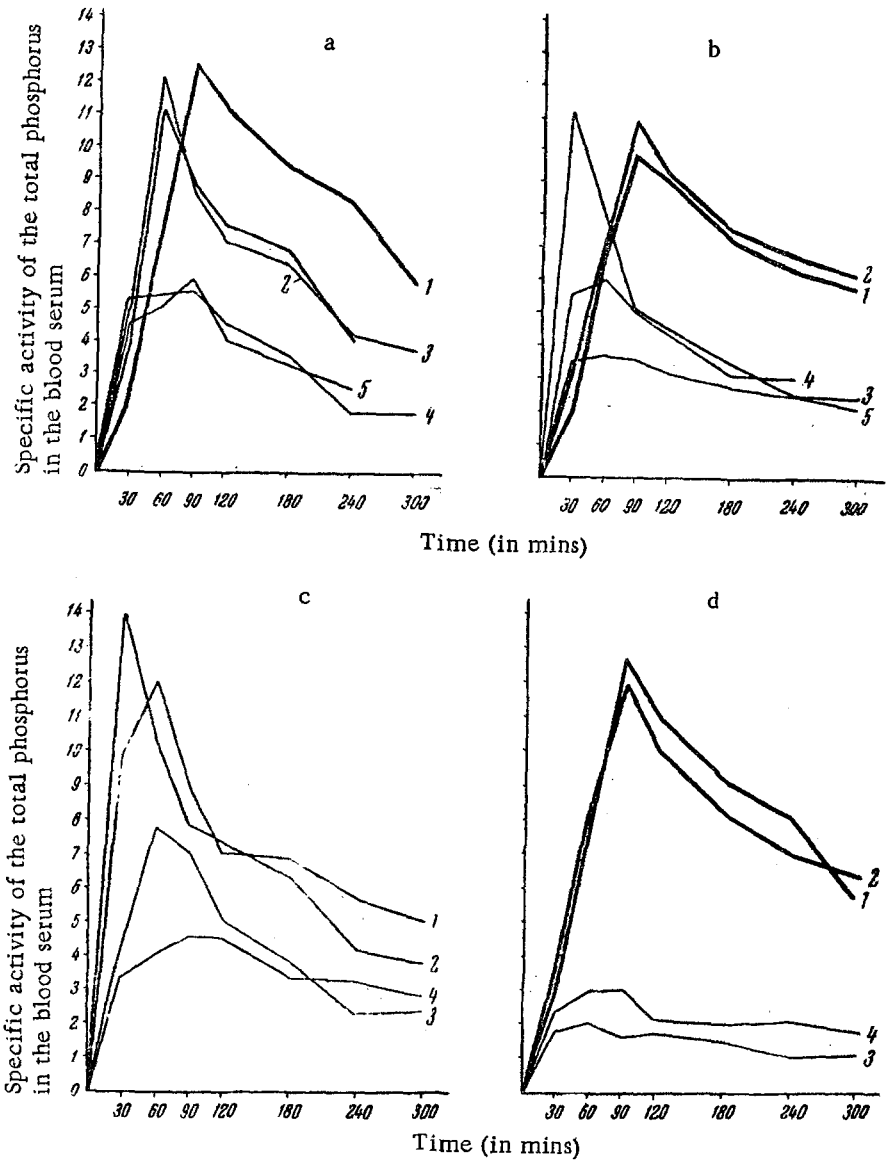

Fig. 1. Rate of resorption of P^{32} from the digestive tract and its utilization under normal conditions and at various times after stomach resection. a) The dog Rus: curve 1) Normal conditions; after resection of the stomach: curve 2) after one month; curve 3) after three months; curve 4) after seven months; curve 5) after eleven months; b) the dog Veta: curves 1 and 2) Normal conditions; after resection of the stomach: curve 3) after three months; curve 4) after ten months; c) the dog Silacs after resection of the stomach: curve 1) after one month ten days; curve 2) after three months ten days; curve 3) after six months; curve 4) after 12 months; d) the dog Naf: the curves 1 and 2) normal conditions; after resection of the stomach: curve 3) after four months; curve 4) after 14 months.

Radioactive sodium phosphate ($Na_2 HP^{32}O_4$) in a dose of 100-200 counts per 1 g weight was given to the dogs on an empty stomach in a mixture of milk and water (total volume 150-200 ml). The blood was taken at strictly observed intervals after the administration of P^{32} (after 30, 60, 90, 120, 180, 240, 300, and 360 mins). The total phosphorus content and the radioactivity of the blood serum were estimated. The specific activity of the total phosphorus of the blood serum was estimated by the method described in earlier publications [4].

EXPERIMENTAL RESULTS

Altogether 24 experiments were carried out.

In the first period after the resection of the stomach (after two-four months) a more rapid resorption of P^{32} from the digestive tract could be observed – a fact indicated by the shift of the peak of radioactivity in the blood serum to the left, i.e., nearer to the moment of injection of P^{32}. Here the radioactivity of the blood decreased more rapidly than under normal conditions (Fig. 1, a, b, c).

The more rapid resorption of P^{32} from the intestine into the blood observed in the first period after the resection of the stomach is connected with the accelerated evacuation from the stomach taking place in these dogs after the operation (see previous paper) [5]. In a subsequent series of experiments carried out to confirm this conclusion P^{32} was ingested into the digestive tract of the dog Tsyganka, (the stomach of which animal was intact,) by two methods: perorally and through a duodenal fistule. Fig. 2 shows a shift to the left in the peak of the specific activity of the total phosphorus and inorganic phosphorus in the blood serum after the second method of ingestion of P^{32} (directly into the gut).

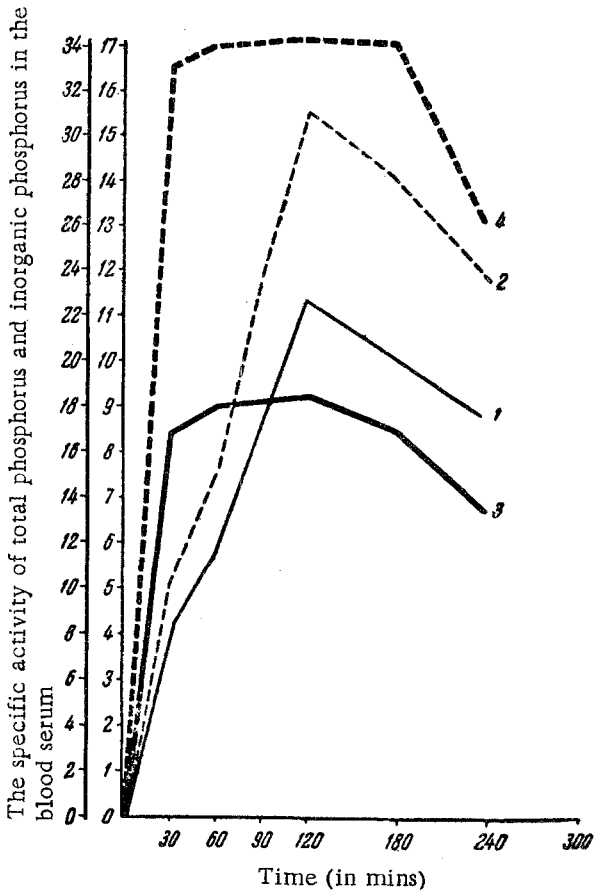

Fig. 2. The dog Tsyganka. The specific activity of total phosphorus (curves 1 and 3) and of inorganic phosphorus (curves 2 and 4) in the blood serum after injection of P^{32} by different methods: curves 1 and 2) per os; curves 3 and 4) through a duodenal fistule. The scale of inorganic phosphorus has been reduced to one half of the scale used for the total phosphorus in the blood serum.

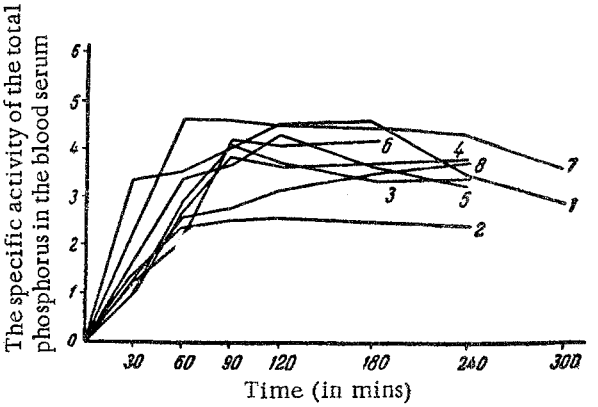

Fig. 3. The rate of resorption of P^{32} from the digestive tract and its utilization in dogs suffering from hepatitis. Curve 1) Igra; curve 2) Atos; curve 3) Belka; curve 4) Kroshka; curve 5) Kerzon; curve 6) Malyshka; curve 7) Mops; curve 8) Klyaksa.

At later periods marked changes take place in the character of resorption and utilization of sodium phosphate. Two-four months after the stomach resection the curves characterizing the specific activity of the total phosphorus in the blood serum become, with regard to their character, more similar to those obtained in dogs suffering from pathological conditions of the liver (Fig. 1, a, b, c, d).

By comparison, we present in Fig. 3 earlier findings concerning the resorption and utilization of P^{32} in dogs known to be suffering from liver lesions.

The findings obtained by us warrant the conclusion that stomach resection leads to disorders in the liver function. This conclusion was confirmed by histological investigation.

N. A. Nilova carried out histological investigation of the liver tissues in three dogs within 6-12 months after stomach resection. In the dog Silacs atrophic liver cirrhosis was found. In the dogs Jack and Rus vacuolization of the liver cells of varying degree could be found. In some cases the nuclei of the liver cells were pycnotic, the liver parenchyma was infiltrated with leucocytes and lymphocytes, the intralobular venous capillaries between the strands of liver cells were narrowed, and other changes could be seen.

In the papers of I. M. Lipets [8], I. T. Kurtsin [6], and L. I. Belorybkina [1], the authors emphasize the close functional interrelation between the stomach and the liver. There are also reports in the literature concerning pathological changes in the liver and bile ducts after stomach resection [9, 10, and others].

In our experiments it could be established that notwithstanding the more rapid evacuation of food from the stomach stump in the dogs at various periods after the operation the resorption of P^{32} from the intestine decreased in later periods. How can we explain the fact that the character of resorption of protein breakdown products and phosphate changes at various periods after the operation?

The pathological process in the liver which gradually develops after stomach resection apparently has a different influence upon the amino-acid metabolism and inorganic phosphorus metabolism in the liver. It may be that the processes of protein synthesis in the liver* are affected to a lesser degree and the rate of phosphorus metabolism in the liver undergoes more marked changes. For this reason the changes which take place after stomach resection in the rate of resorption and utilization of breakdown products of casein labelled with I^{131} and methionine labelled with S^{35} remain in the period following the operation on one and the same level: the level and the character of the radioactivity in the blood remain unchanged.

SUMMARY

The rate of P^{32} absorption from the digestive tract and of its utilization in the organism was studied at various intervals after subtotal resection of the stomach in 7 dogs. Radiophosphorus was given to dogs per os in water-milk mixture. The content of total phosphorus and its radioactivity were examined in the blood serum at various periods; its specific activity was estimated as well.

The rate of P^{32} absorption from the digestive tract was increased and a maximal rise of blood radioactivity was shifted to the left in dogs with subtotally resected stomach (as compared to the control animals). With the passage of time the character of P^{32} absorption from the digestive tract was changed in the animals with subtotally resected stomach; the rate of P^{32} utilization from the blood was altered as well. Specific activity of the blood became similar to that in dogs with parenchymatous hepatitis. P^{32} absorption remained altered at remote time periods after the resection of the stomach (the longest period of observation—16 months), being evidently connected with the structural changes in the liver occurring in these conditions.

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* S. M. Leites and G. T. Pavlov [7] observed, in rats afflicted by severe liver lesions, marked changes in the rate of protein synthesis in the liver.