ABSORPTIVE POWER OF THE ALIMENTARY TRACT AFTER RESECTION OF THE DISTAL HALF OF THE SMALL INTESTINE

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Resection of the distal half of the small intestine caused a prolonged decrease in the rate of absorption of methionine-S^{35} which persisted for 4-5 months.

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A disturbance of the absorptive and metabolic functions of the alimentrary tract has been observed after removal of various segments of the small intestine in clinical and experimental investigations [1-3, 7, 8]. No precise details of the changes in absorptive power of the alimentary tract after resection of the proximal (jejunum) or distal (ileum) segments of the small intestine, however, are yet available [1].

We have previously shown than resection of the proximal half of the small intestine leads to considerable disturbances of absorption and utilization of a number of substances [4].

In the present investigation absorption of the amino acid methionine-S^{35} from the alimentary tract and the rate of its disappearance from the blood stream, together with the rate of incorporation of label (S^{35}) into the serum proteins were studied after resection of the distal half of the small intestine in dogs. In addition, the rate of absorption and utilization of radioactive sodium phosphate ($Na_2HP^{32}O_4$) was studied, providing a test of the state of the liver function [6].

EXPERIMENTAL METHOD

A long-term experiment was conducted on three mongrel dogs from which the distal 50% of the small intestine had been removed.* The length of the portion of small intestine resected was 110-120 cm. Control experiments were performed on the same dogs before the operation and on three intact dogs. The maximal period of observation on the animals was 22 months. Radioactive substances were given by mouth with milk in doses of 200 pulses/min/g body weight 18 h after a meal. Blood samples were taken from the short saphenous vein 30, 60, 90, 120, 180, 240, and 300 min and 24 h after administration of the radioactive material. The total radioactivity of the blood serum was measured with a B-2 apparatus.

The rate of incorporation of S^{35} label into the serum proteins was determined by a method described previously [4].

The results of measurements of methionine-S^{35} were expressed as the ratio between radioactivity in 1 ml of serum and the activity administered per gram body weight, calculated as a percentage. These values were the resultants of two processes: the rate of absorption of the given substance from the alimentary tract and the rate of its elimination from the blood. The relative incorporation of activity into the serum proteins was calculated in per cent.

After administration of P^{32} the total phosphorus in the serum was determined by K. S. Zamychkina and D. É. Grodzenskii's modification of the Fiske–Subbarow method [5] and its radioactivity was measured. The specific activity of the serum was calculated [6].

*Operations were performed by B. I. Sabsai.

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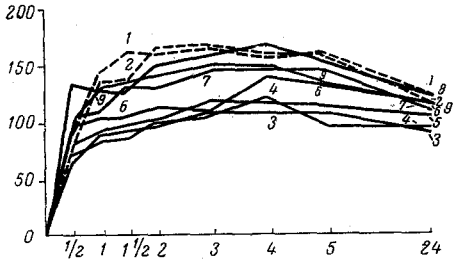

Fig. 1. Rate of absorption and utilization of methionine-S^{35} after resection of the distal half of the small intestine in the dog Mishka. 1, 2) Control experiments; 3) 26 h after operation; 4) 3 months 12 days after; 5) 5 $^1/_2$ months after; 6) 8 months 20 days after; 7) 10 months; 8) 18 months; 9) 20 $^1/_2$ months after operation. Ordinate, relative activity of serum (in % of dose administered per gram body weight); abscissa, time in hours.

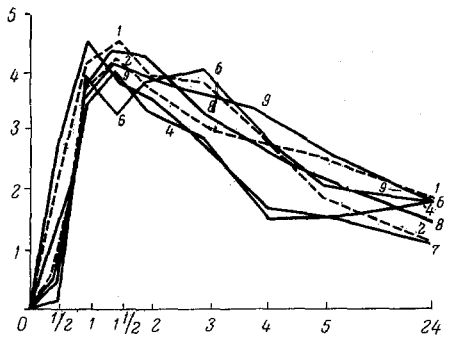

Fig. 3. Rate of absorption and utilization of sodium phosphate ($Na_2HP^{32}O_4$) from the alimentary tract in the dog Mishka. 1, 2) Control experiments; 3) 1 month, 4) 3 months; 5) 5 months 6) 7 months 20 days; 8) 13 $^1/_2$ days; 9) 17 months after operation. Ordinate, specific activity of total serum phosphorus; abscissa, time (in hours).

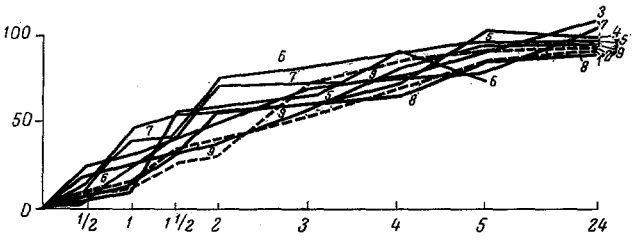

Fig. 2. Rate of incorporation of methionine-S^{35} into serum proteins of the dog Mishka. 1, 2) Control experiments; 3) 26 days after operation; 4) 3 months 18 days; 5) 5 $^1/_2$ months; 6) 8 months 20 days; 7) 10 months; 8) 18 months; 9) 20 months after operation. Ordinate, relative activity of protein (in %); abscissa, time (in hours).

EXPERIMENTAL RESULTS

The results of investigation of methionine-S^{35} absorption in the dog Mishka after resection of the distal portion of the small intestine are illustrated in Fig. 1. One month after the operation the blood radioactivity level had fallen to 120%, compared with the control value of 160%. A similar decrease in the absorption and utilization of methionine was observed for 4-5 months after resection of the distal portion of the small intestine. Later in the investigation the rate of absorption of methionine-S^{35} increased gradually to the control level, at which it remained for the remainder of the period of observation (until 20 months after operation).

In one dog (Chita) a considerable rise of the radioactivity of the blood to 310% was observed in a later period of the investigation 18-20 $^1/_2$ months after operation following administration of methionine-S^{35} into the alimentary tract. This increase in radioactivity of the blood may be due either to an increase in the rate of absorption of methionine from the alimentary tract or to a fall in the rate of utilization of this amino acid from the blood by organs and tissues. A decrease in the utilization of methionine was demonstrated by a marked increase in the blood radioactivity level over normal in blood samples taken 24 h after administration of methionine-S^{35}.

The results of investigation of the rate of incorporation of S^{35} label into the serum proteins showed that in all the dogs the percentage incorporation of radioactivity into proteins after resection of the distal half of the small intestine was indistinguishable from normal, reaching 100% 24 h after administration of methionine-S^{35} (Fig. 2). An exception was the dog Chita, in which the rate of incorporation of radioactivity into the serum proteins was reduced parallel with the disturbances in absorption and utilization of methionine noted above.

The results obtained in the study of the rate of absorption and utilization of radioactive phosphorus (P^{32}) after resection of the distal half of the small intestine (Fig. 3) were indistinguishable from the controls. Only with the dog Chita was a decrease in the rate of absorption and utilization of P^{32} observed 17 $^1/_2$ months after the operation. We observed a similar phenomenon in dogs after resection of the proximal segment of the small intestine, but sooner after the operation. In dogs with experimental hepatitis, K. S. Zamychkina showed that such a disturbance of the rate of absorption and utilization of inorganic phosphorus is characteristic of liver disease.

Histological examination of liver sections from dogs after resection of the distal portion of the small intestine revealed no morphological changes; in the dog Chita the initial stage of fatty infiltration of the liver was observed.*

Clearly resection of the distal portion of the small intestine does not lead to such a marked and rapid disturbance of the absorptive and metabolic function of the alimentary tract as was observed after resection of the proximal portion. However, in the later periods after resection of the distal portion of the small intestine disturbances of absorption and utilization of food substances may arise. This indicates the importance of more prolonged observations on the state of patients undergoing extensive resection of the small intestine.

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