

THE ROLE OF VARIOUS SECTIONS OF THE DIGESTIVE TRACT IN THE EXCRETION OF RADIOACTIVE CALCIUM

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The significance of various sections of the digestive tract in the excretion of calcium has not been demonstrated adequately. Some authors maintain that the larger portion of excreted calcium is discharged by the large intestine [1, 6], while others deny that the large intestine participates in this process [2, 4]. Some investigators believe that calcium is not excreted by the digestive tract at all [3], and a number of authors have postulated that it is excreted by all divisions of the gastro-intestinal tract [5]. Information on excretion of calcium with the gastric juice or bile is scanty, and we failed to find any reports in the literature on the excretion of calcium with the pancreatic juice. At the same time, a study of the excretion of Ca^{45} and certain other radioactive isotopes (Sr^{90} , Ra^{228}) holds definite interest, since the acceleration of this process bears practical importance in poisonings with radioactive substances.

EXPERIMENTAL METHOD

The excretion was studied in a long-term experiment on 9 dogs (1 – with a Pavlovian stomach, 2 – with sections of small intestine isolated according to the method of Tiri-Vella, 2 – with sections of large intestine isolated according to Tiri; in 2 dogs the bile duct was externalized according to the method of Pavlov, and in 2 – the pancreatic duct). The animals entered into the experiment with empty stomachs. Secretion of gastric and pancreatic juice, as well as bile, was stimulated by a feeding with 100 grams of meat. Secretion of intestinal juice was caused by washing the isolated section of small intestine with a suspension of calomel. Since secretion of juice from the fistula of the large intestine was minimal, the washing waters were used in the investigation. Radioactive calcium (Ca^{45} , Cl_2) was injected intravenously (10 microcuries per kg of weight of the animals). The fluids to be studied were collected every 15-30 min, over a period of 5-6 h. The radioactivity was measured with a surface counter. Comparing the total radioactivity of the fluids obtained in the experiment with the radioactivity of the injected Ca^{45} , Cl_2 solution, we calculated the amount of Ca^{45} excreted by the fistulas of the sections of digestive tract that were studied. The excretion of Ca^{45} was traced for a period of 2-3 weeks.

EXPERIMENTAL RESULTS

The character of excretion of Ca^{45} is quite similar throughout the different sections of the gastro-intestinal tract. Thus, after intravenous injection of Ca^{45} , it appeared after 3-5 min in the gastric, intestinal and pancreatic juice, as well as in the bile and the washing waters obtained from the fistula of the large intestine. In the course of the first 1-1½ h of the experiment, and often even after 15-30 min, the radioactivity of the digestive juices and bile sharply increased, attaining its maximum. Then the level of Ca^{45} concentration in the obtained fluids decreased (Fig. 1 and 2). With the reduction in radioactivity, we could no longer demonstrate it in the samples of digestive juices, bile or washing waters after 10-15 days. After repeat injections of Ca^{45} , the duration of its excretion by the digestive tract rose to 1-1½ months.

The concentration of Ca^{45} in the gastric juice was low, and after 5 h of the experiment was equal to 0.02-0.03% of the injected amount. The rise in the level of radioactivity was expressed mildly (see Fig. 1), and did not last long – 15-20 min after the injection; Ca^{45} stopped being demonstrable in the gastric juice somewhat earlier than in the intestinal and pancreatic juice and the bile (after 7-10 days). In the intestinal juice, obtained from the small intestine fistula, the concentration of Ca^{45} was somewhat greater: after 4-5 h of the experiment, 0.04-0.06% of the injected amount was excreted. Corresponding to this, the rise in the level of radioactivity for the intestinal juice was greater than in the experiments with gastric juice. The radioactivity of the washing waters obtained from the fistulas

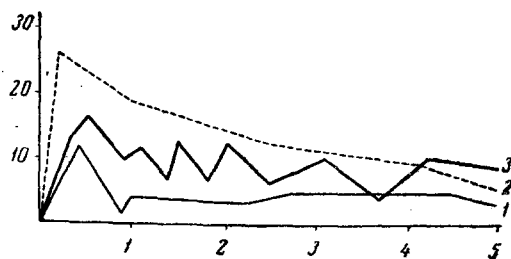


Fig. 1. Excretion of Ca^{45} by isolated sections of the stomach and intestine. 1) Radioactivity of the samples of gastric juice; 2) of intestinal juice; 3) of washing waters, obtained from fistulas of the large intestine. On the ordinate — radioactivity, expressed in $1 \cdot 10^{-4}$ of the injected amount of $\text{Ca}^{45} \text{Cl}_2$. On the abscissa — time in h.

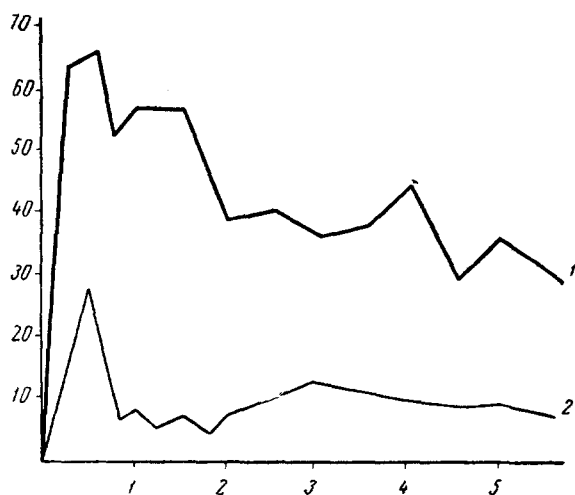


Fig. 2. Excretion of Ca^{45} with the bile and pancreatic juice. 1) Radioactivity of the samples of bile; 2) of pancreatic juice. Remaining designations are the same as in Fig. 1.

appreciable amounts of calcium. The possibility of reabsorption of the Ca^{45} excreted by the liver and pancreas decreases the importance of these organs in the excretion of this substance from the organism. Large amounts of Ca^{45} were excreted by the isolated section of large intestine. Reabsorption in this division of the digestive tract is low, and thus, the large intestine may play an essential role in the excretion of calcium from the organism.

SUMMARY

Excretion of radiocalcium with digestive fluids was studied in long-term experiments on dogs after intravenous injection of this substance. Investigations were carried out on experimental animals with isolated portions of the stomach, of the small and large intestine, as well as with exteriorized bile and pancreatic ducts. As established, the greatest amount of Ca^{45} was excreted with bile (up to 1% of the dose administered) and by the large intestine fistula (0.2-0.4% of that administered). The least amount of Ca^{45} was excreted with the stomach juice (0.02% of the injected dose).

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of large intestine, which characterized their concentration of Ca^{45} , ranged around a constant level over the course of the first 5-6 h of the experiment, and then gradually decreased up to the 15-20th day (see Fig. 1). Significant amounts of Ca^{45} were excreted with the washing waters and mucus (0.1-0.4% of the injected amount during the experiment, i.e., considerably more than by the isolated sections of small intestine of the same or greater length). It should be noted that the mucus produced by the large intestine showed a high radioactivity. According to our data, mucus takes an active part in the process of excreting Ca^{45} from the organism. In the pancreatic juice, the level of radioactivity was quite high only a few minutes after the injection of Ca^{45} (see Fig. 2). During the experiment, 0.15-0.25% of the injected amount of Ca^{45} was excreted with the pancreatic juice.

Excretion of Ca^{45} with the bile was the most intense. Only 15 min after its injection, the radioactivity of the bile samples was very high, and exceeded the radioactivity of samples of the other digestive juices by 2-3 times for corresponding time intervals (see Fig. 2). A high level of radioactivity was maintained throughout the course of the entire experiment. Five hours after the time of injection, 0.7-1% of the injected amount of Ca^{45} was excreted with the bile, which represents a very significant quantity. This testifies to a great intensity of Ca^{45} excretion with the bile.

From the experimental data presented, it follows that Ca^{45} excretion occurs throughout the entire length of the digestive tract. Small amounts of Ca^{45} are excreted in the isolated section of the stomach. Apparently, the stomach does not play an essential role in the processes of calcium excretion from the organism. Isolated sections of the small intestine also excrete comparatively small amounts of Ca^{45} . However, considering the great length of the small intestine (the size of the isolated portions that were studied was equal to 20-22 cm), it may be postulated that, on the whole, the small intestine excretes

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