THE EFFECT OF ATROPINE ON THE RATE OF ABSORPTION OF INORGANIC PHOSPHATE ($Na_2HP^{32}O_4$) FROM THE ALIMENTARY TRACT AND ON THE RATE OF ITS UTILIZATION FROM THE BLOOD IN NORMAL CONDITIONS AND IN LIVER DISEASE

K. S. Zamychkina

Laboratory of the Physiology and Pathology of Digestion (Head – Professor S. I. Filippovich), Institute of Normal and Pathological Physiology (Director – Active Member AMN SSSR V. V. Parin) of the AMN SSSR, Moscow
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The action of atropine on the secretory and evacuatory functions of the stomach has been extensively studied. It is known to be exerted in both the first and the second phases of gastric secretion [1]. Meanwhile, the action of atropine on metabolism, of which the first step is the process of absorption in the alimentary tract, has received little attention. The study of the action of atropine on the absorptive function of the alimentary tract is interesting because atropine is widely used in therapeutic practice.

We have studied the effect of atropine on the rate of absorption of inorganic phosphate ($Na_2HP^{32}O_4$) from the alimentary tract and on the rate of its utilization from the blood stream. With the object of determining the importance of the functional state of the liver, experiments were conducted on healthy dogs and also on dogs with pathological changes in the liver.

EXPERIMENTAL METHOD

Atropine was injected subcutaneously in a dose of 0.05 mg/kg body weight, either soon after the oral administration of $Na_2HP^{32}O_4$ (P^{32}) in 250 ml of milk, or 60 min after administration of P^{32}, i.e., at the time when the level of the radioactivity of the blood was at its highest. The difference in the experimental method was dictated by the necessity of studying the effect of atropine not only on the absorption and utilization of P^{32} in the organism as a whole, but also on the rate of its utilization from the blood stream.

In these experiments we used dogs with liver damage caused by carbon tetrachloride (CCl_4), and also dogs in which pathological changes in the liver arose as a result of infection from the bile ducts or from other causes [3]. Hepatitis was diagnosed while the animals were alive by means of a function test consisting of loading with glucose. The principal signs of pathological changes in the alimentary tract were obtained by subsequent histological investigation of the liver and the other digestive organs.

Blood was taken from the lesser saphenous vein at strictly measured time intervals after administration of P^{32} (15, 30, 60, 90, 120, 180, 240, and 300 min). The total and inorganic phosphorus and their radioactivity in the blood serum were determined, and their specific activity was calculated by a method which we have described earlier [2]. Altogether 35 experiments were performed on 8 dogs.

EXPERIMENTAL RESULTS

In the healthy dogs, a marked slowing of the absorption of P^{32} by comparison with control experiments was observed after injection of atropine. The utilization of phosphate in the body was also modified. The specific activity of the total serum phosphorus did not fall during the period from 120 to 240 min after administration of P^{32}, as was usually observed in the control experiments, but actually rose, indicating a slowing of the rate of utilization of P^{32} in the body under the influence of atropine (Fig. 1).*

*We cite only the values of the specific activity of the total serum phosphorus; the change in the specific activity of

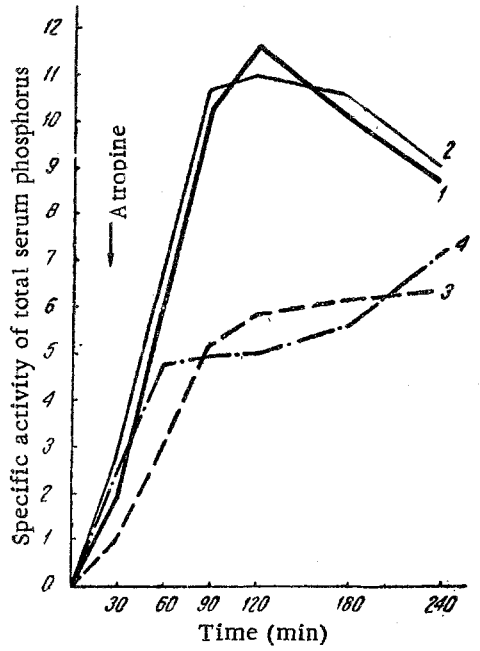

Fig. 1. Effect of atropine on the rate of absorption and utilization of P^{32} in the body after oral administration to healthy dogs. 1,2) Control experiments; 3,4) injection of atropine.

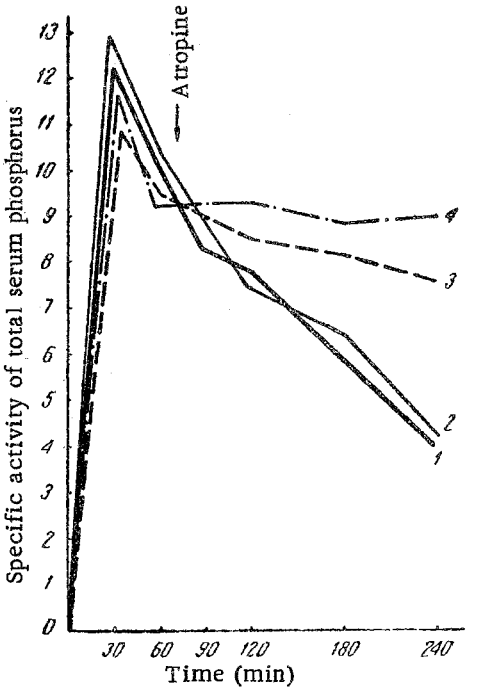

Fig. 2. Effect of atropine on the rate of utilization of P^{32} from the blood stream after subcutaneous injection into healthy dogs. 1,2) Control experiments; 3,4) injection of atropine.

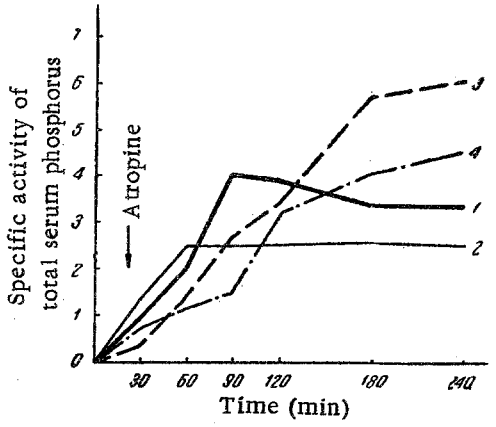

Fig. 3. Effect of atropine on the rate of absorption and utilization of P^{32} in the body when given by mouth to dogs with liver disease. 1,2) Control experiments; 3,4) injection of atropine.

In preliminary experiments, when P^{32} was injected subcutaneously, the maximal increase in radioactivity was usually observed after 30 min, after which it gradually fell. In experiments in which atropine was injected, the level of radioactivity of the blood was not lowered by comparison with the controls, but remained within the limits observed at the moment of injection of the atropine, or rose. In Fig. 2 we give the results of the investigations on two dogs (Rozka and Tsyganka) – similar results were obtained in the experiments on the other dogs.

Hence, in the healthy dogs the effect of atropine was to cause a considerable decrease in the absorption of inorganic phosphate from the alimentary tract and in its utilization in the body.

We have previously reported [3] that the rate of absorption of P^{32} and the rate of its utilization from the blood in dogs with pathological changes in the liver differ considerably from the corresponding rates in healthy dogs. The level of the radioactivity of the blood in the affected dogs was lower and their rate of utilization of P^{32} from the blood was diminished.

The results of investigations on the dogs Belka and Atos, with pathological changes in the liver, are shown in Fig. 3. The curves of the specific activity of the total serum phosphorus were low and more sloping than normally, a characteristic feature of dogs with disturbances of liver function.

the inorganic phosphorus always coincided with that of the total phosphorus. We know that during the first 24 hours, P^{32} circulates in the plasma mainly in the form of inorganic phosphate.

After injection of atropine, the rate of absorption of P^{32} from the alimentary tract was slowed. The character of utilization of P^{32} from the blood stream underwent particularly marked changes. The level of the radioactivity of the blood was higher than in the preliminary experiments: an accumulation of P^{32} in the blood was observed, and was evidently associated with the considerable disturbance of the phosphorus metabolism in the liver. When an injection of atropine was given after the subcutaneous injection of P^{32}, a marked slowing of the utilization of P^{32} from the blood stream was also observed.

These findings afford further confirmation of the inhibiting action of atropine on the rate of utilization of phosphate in the body.

By modifying the functional state of the nervous system (parasympathetic, intramural), atropine thus causes marked disturbances of the activity of the entire alimentary tract. Atropine is known to have a considerable retarding action on the evacuatory, motor function of the stomach, and this in turn affects the rate at which food enters the intestine and, consequently, the subsequent character of the absorption and utilization of a given substance. Furthermore, by blocking the autonomic nervous system to some degree, atropine thereby modifies the metabolic processes in the liver and other organs, which also affects the rate and character of the utilization of phosphate in the body.

Hence, the changes in the rate of utilization of phosphate taking place after administration of atropine to animals are associated, on the one hand, with changes in the rate of its absorption and, on the other hand, with changes in the phosphorus metabolism in the body. When pathological changes are present in the liver, atropine has a particularly marked effect on the intensity of the phosphorus metabolism.

SUMMARY

An inquiry was made into the effect of atropine on the rate of inorganic phosphate ($Na_2HP^{32}O_4$) absorption from the digestive tract and the rate of its utilization from the blood of healthy dogs and those suffering from parenchymatous hepatitis. Atropine reduces the phosphate absorption from the digestive tract and its utilization from the blood of healthy dogs. In cases of liver pathology, the effect of atropine on the rate of P^{32} utilization from the blood is particularly pronounced.

LITERATURE CITED

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