

AFFERENT PATHWAYS OF REFLEX INFLUENCES FROM THE STOMACH ON DIURESIS

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In recent years (1952-1954), work has appeared which was dedicated to the study of the changes in urine excretion when the mechanical and thermal receptors of the stomach are stimulated. The authors of the works tried to study some aspects of the mechanism of the indicated influences [2,4,5].

We also studied the influence of the stomach interoceptors on diuresis when the mechanical receptors of the stomach are stimulated [3]. In this communication the experimental results of a study of the afferent pathways of these reflex influences are presented.

EXPERIMENTAL METHODS

The experimental method was described in detail in the preceding communication [3]. A series of experiments were set up with 7 dogs. In order to clarify the hypothesized reflex nature of the influences of the stomach on diuresis, experiments were set up with two dogs (called Toby and Silva) whose stomach had been isolated by G. M. Shpuga's method [6] and on one dog (Lokhmaty) with a stomach denervated and isolated by the modified method of Klemensievich-Heidenhain. The orifices of the ureters of the first two dogs were brought out on the skin of the abdomen. The isolated stomach of all three dogs was irritated with a small balloon which was filled with water; the strength of the irritation was controlled inside the balloon according to the pressure of a mercury column in millimeters. The afferent reflex pathways were studied in dogs with a gastric fistula and with the orifices of the ureters brought out to the skin of the anterior abdominal wall. The irritation of the mechanical receptors of the stomach was carried out with the help of a rubber balloon which was introduced through the fistula into the stomach and was filled with 200, 400, 600, or 800 ml of water at a temperature of 38°. Sometimes larger amounts of water were introduced. After the control experiments, both of the large gastric nerves of one of the experimental dogs (Pushka) were cut below the diaphragm, both vagosympathetic trunks of two other dogs (Alma and Shar) were cut at the neck. In order to study the afferent pathways entering into the spinal cord, the spinal cord of the dog Vesely was cut at the level of the VI-VII thoracic vertebrae. The vagosympathetic trunks of the last two dogs were later cut at the neck.

EXPERIMENTAL RESULTS

In investigating the mechanism of the influences under study, it was necessary first of all to discover whether they are only reflex or whether they may also take place in a humoral way with very strong irritation. Dilation of the isolated innervated stomach of the dogs Toby and Silva with a balloon with a pressure of 40-60 mm of mercury caused a distinct inhibition of urine formation. Dilation of the denervated isolated stomach of the dog Lokhmaty at the same and greater (up to 150 mm of mercury) pressure did not cause any change in spontaneous diuresis. It follows from this that the influences from the stomach on diuresis are of a reflex nature.

In further experiments the afferent pathways of this reflex were studied. The influence of the stomach on the diuresis of the dog Pushka after both large gastric nerves were cut below the diaphragm did not change substantially. After the vagosympathetic trunks of two other dogs (Alma and Shar) were cut at the neck, these influences decreased only slightly.

Since we did not find a cessation of or a substantial change in the influence of the gastric interoceptors on diuresis, either when the vagosympathetic trunks were cut in the neck region or when the gastric nerves were cut below the diaphragm, we decided to study the effect of sectioning the spinal cord on these reflexes. When the spinal cord was cut at the VI-VII thoracic vertebrae, the effect of the interoceptors decreased somewhat, but did not cease (dog Vesely). When the spinal cord of the dog Zhuchok was cut at the level of the VII cervical-I thoracic vertebrae the effect of the interoceptors also did not change substantially.

Thus, not one of the indicated sectionings of the hypothesized afferent reflex pathways disturbed the effect of the reflex influences from the stomach on diuresis. It could be supposed that the reflex influences *ex* from the stomach on diuresis occur by no single pathway, but by two or more.

In order to solve this problem, the vagosympathetic trunks in the cervical region of the dog Vesely, whose spinal cord had been cut at the level of the VI-VII thoracic vertebrae previously, were also cut. The results of the experiment are shown in Fig. 1. If, after section of the spinal cord, dilation of the stomach with a balloon caused the inhibition of the diuresis usual in healthy dogs, then after the supplementary section of the vagosympathetic trunks the same irritation caused a paradoxical reaction. This reaction, possibly, can be explained by the great changes in the organism which occur due to the indicated operations. From the present experiment it can be concluded that the influence of the stomach on diuresis is preserved in the presence of the combined sectioning, although in a distorted form.

The vagosympathetic trunks in the cervical region of the second dog (Zhuchok) whose spinal cord had been cut at the level of the VII cervical-I thoracic vertebrae, were also cut. While dilation of the stomach with a balloon after the high section of the spinal cord caused considerable inhibition of urine formation, after the supplementary section of the vagosympathetic trunks on the neck the same dilation did not change urine formation substantially (Fig. 2); as before, so after dilation of the stomach, urine formation was of an undulant nature which was not affected by the irritation of the gastric interoceptors.

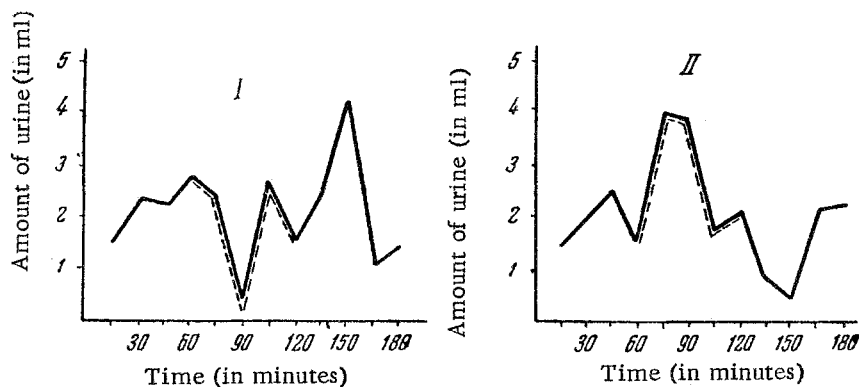


Fig. 1. Change in the spontaneous formation of urine when the stomach of the dog Vesely, whose spinal cord had been sectioned at the level of the VI-VII thoracic vertebrae, was dilated with a balloon filled with water (1200 ml at 38°).

I) experiment on 18 November 1952; II) experiment on 20 November 1952 (2nd day after sectioning both vagosympathetic trunks in the neck). Continuous line-diuresis of both kidneys (in ml), dotted line - time the balloon remained in the stomach (in minutes). 1) Amount of urine (in ml) 2) Time (in minutes).

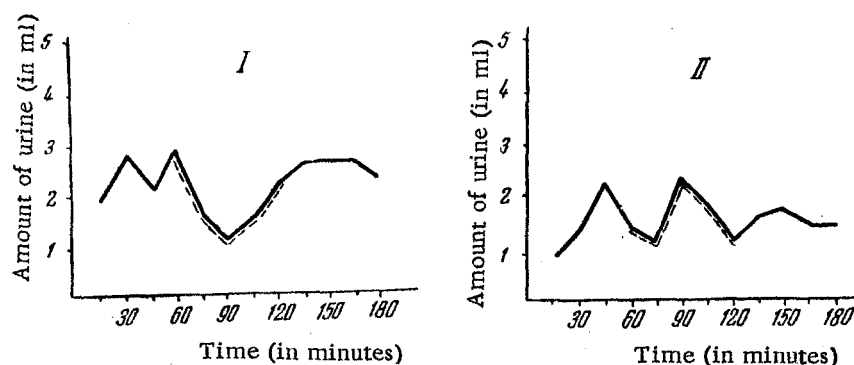


Fig. 2. Change in the spontaneous formation of urine by the Dog Zhuchok whose spinal cord was cut at the level of the VII cervical-I thoracic vertebrae when the stomach was dilated by a balloon filled with water (800 ml at 38°).

I) experiment on 21 February 1953; II) experiment on 27 February 1953. (2nd day after sectioning both vagosympathetic trunks at the neck). Continuous line - diuresis of both kidneys (in ml), dotted line - time the balloon remained in the stomach (in minutes).

The results of these experiments show that when the spinal cord is sectioned at a high level (VII cervical-I thoracic vertebrae) and both vagosympathetic trunks in the cervical area are sectioned subsequently, the influence of the stomach on diuresis is not realized. Apparently, under these conditions, both types of afferent pathways of the gastric-renal reflex were destroyed: the vagosympathetic trunks and the spinal cord. The results of our investigations coincide with the data of Bain, Irving and McSwiney [7], and with the experimental results of K. M. Bykov and V. N. Chernigovsky [1] on the afferent pathways of the gastric interoceptor reflexes.

SUMMARY

We have studied changes in diuresis on dogs by stimulating mechanoreceptors of stomach and afferent pathways of this reflex. Cutting of ventral nerves under the diaphragm and vagosympathetic trunks of the neck did not disturb the influence from stomach on diuresis. Only when the spinal cord is cut at the level of the VII cervical-I thoracic vertebrae and also both vagosympathetic trunks in the cervical area, were no reflex influences from the stomach on diuresis observed.

Apparently, the afferent pathways of reflex influence from the stomach on diuresis are the vagosympathetic trunks and the spinal cord.

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