DIURESIS AFTER WATER IS GIVEN PER RECTUM

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It is usually thought that the increase in diuresis which follows a water load (water diuresis) is caused chiefly by a reflex originating in the receptors of the tissues and vessels, and brought about by changes in the secretion of the antidiuretic hormone of the hypothesis. (The mechanism of the osmoregulatory reflex has been studied in recent years in a laboratory directed by Professor A. G. Ginetsinskii.)

A large number of experimental results also indicate that reflex influences from the upper part of the digestive tract originating in the act of drinking itself also play an important part [2, 6, 7]. These influences are particularly significant in connection with the rapid onset of water diuresis. This circumstance may explain the numerous observations of the less definite diuresis which follows parenteral introduction of fluid [10, 11, 13].

It therefore seemed worthwhile to examine the process of diuresis following the administration of water rectally, a procedure which eliminates any reflex effects from the upper part of the gut.

METHOD

The work was carried out as chronic experiments on five dogs in which the ureters were exteriorized by the method of Pavlov-Tsitovich. The food ration was maintained as nearly as possible constant. It was given once per day, 16-18 hours before the beginning of the experiment. Before the experiment, the animals were taken for a walk in order to empty the lower part of the intestine.

A water load of 300 ml was given either as a drink, in which case 10% milk was added to the water, or rectally over a period of 15-20 minutes through a rubber catheter. The experiment lasted six hours, and urine was collected at half-hour intervals. Besides urinary excretion, measurements were made of filtration and reabsorption, and of the hydremic response to drinking water or receiving it rectally.

Filtration and reabsorption was determined from the endogeneous creatin. In addition to the actual values of filtration and reabsorption, the changes in these quantities were also significant. The hydremic response was determined from the dry residue, which according to many authors [5, 13, and others] represents the most direct and accurate indication.

In all, 71 experiments were carried out, in 28 the fluid was presented as a drink, and in 43 the water was given rectally. Filtration and reabsorption were studied in 41 experiments, in 19 of which the dry blood residue was determined. The above quantities were measured several times in each experiment, twice before the water load, and 4-6 times after it.

RESULTS

In th 28 experiments in which water was given by mouth, there was a large increase in diuresis which started within half-an-hour of drinking (Fig. 1). After 3 hours, diuresis again fell. The marked increase was

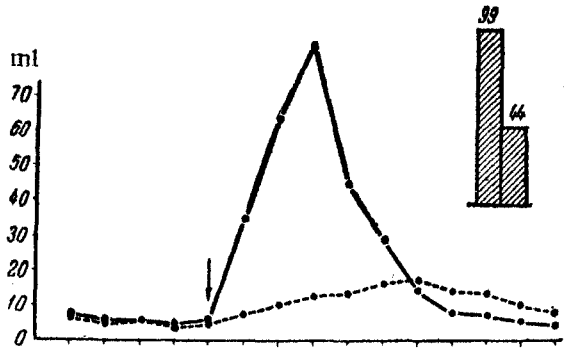

Fig. 1. Change in diuresis in the dog Belka after drinking 300 ml of water (continuous line represents mean of 12 experiments) and injecting the same amount into the rectum (dotted line represents mean of 14 experiments). The arrow indicates the moment at which the fluid is introduced. Abscissa – time (each division represents 15 minutes); ordinate – diuresis (in ml). The diuresis is shown as a percentage of the total fluid given, left column after oral, right after rectal administration.

due almost entirely to a reduced tubular reabsorption (Fig. 3), a result which has been repeatedly reported [4, 15, and others]. Filtration showed no very great changes, although in half the experiments the increase in the diuresis during the first half of the period after drinking was partially due to a noticeably increased filtration. In three of the 12 experiments the increased filtration was quite considerable, a result which agrees with the findings of several other authors [1, 3].

Of the 34 experiments in which water was introduced rectally, in three the water diuresis differed little from normal, and in eight there was a marked increase in the urinary excretion which was less well shown, and in 32 the water introduced rectally caused either no increase in diuresis or else one which was very weak and ill defined (Fig. 1). The lag in diuresis after water has been taken in rectally was particularly clearly shown during the first two hours after its administration, and occurred in all the animals (Fig. 2). In the few experiments when the water given per rectum caused a much more marked increased in diuresis, the increased excretion was due chiefly to a reduced reabsorption. It was however much less well shown than in the experiments in which water was taken orally. In the latter case, in almost all the experiments reabsorption was greatly reduced in the first hour after taking the fluid, whereas when it was given rectally the effect was observed only in one out of 28 experiments. During the second and third hour after giving water rectally, there was a marked reduction of reabsorption in only seven of the 28 experiments, whereas when given by mouth the reduction in the reabsorption was very marked and occurred in all cases.

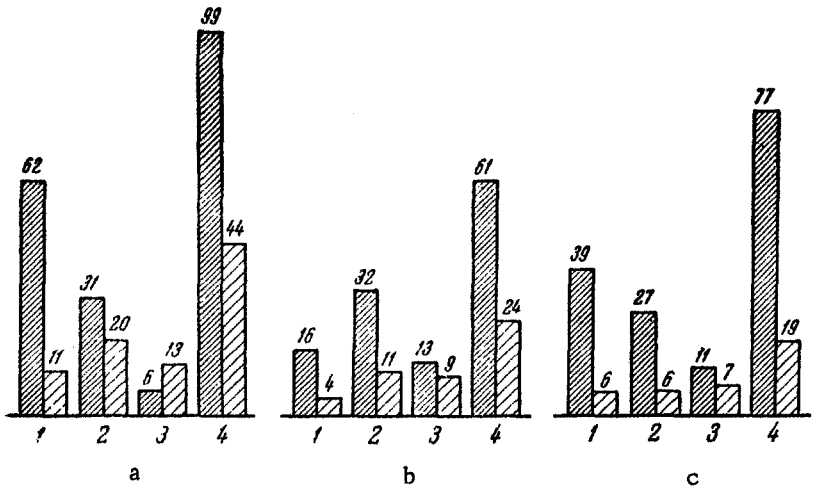

Fig. 2. Change in diuresis after a water load of 300 ml taken either orally (close shading) or rectally (sparse shading) as a percentage of fluid intake. 1) During first hour; 2) during second hour; 3) during third hour; 4) total over three hours; a) in dog Belka (mean of 26 experiments); b) in the dog Tainy (mean of 21 experiments); c) in the dog Diana (mean of 14 experiments).

When the water was given rectally, there was an increase in diuresis due to increased filtration in only four of the experiments. In the remainder, filtration was either unchanged or varied within the previous limits.

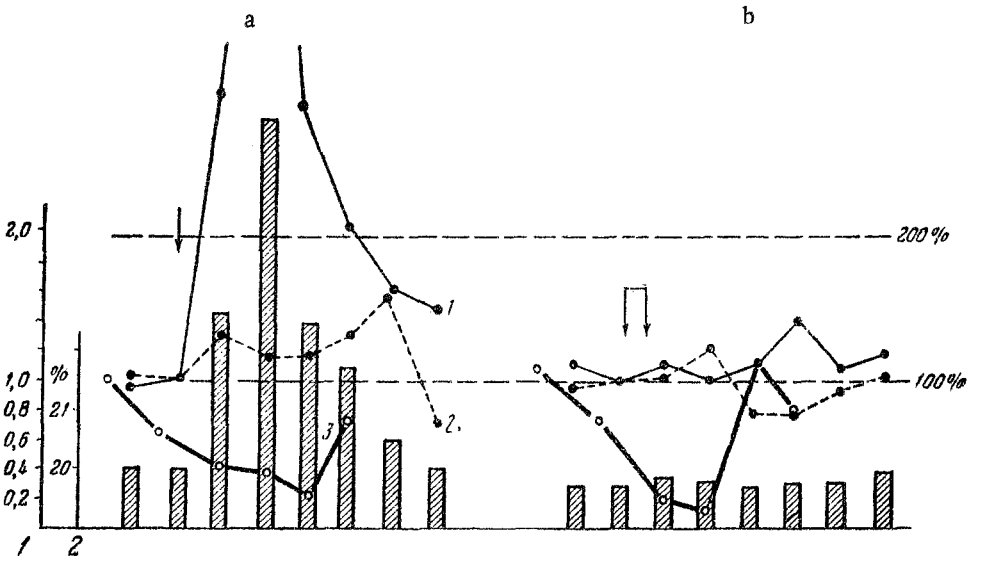

Fig. 3. Effect of a 300 ml water load in the dog Diana on filtration, reabsorption, diuresis, and dry blood residue when the fluid is taken (a) orally and (b) per rectum. Experiments Nos. 21 and 22. 1) Amount of filtrate not reabsorbed (excreted with the urine) as a percentage of the initial amount; 2) filtration (in ml per minute) as a percentage of the original value; 3) dry blood residue as percentage (the arrow indicates the moment at which the water is given, the columns the diuresis). Abscissa – time, 30 minutes intervals; ordinate: 1) diuresis (ml/minute); 2) dry blood residue.

Which ever way the fluid was administered, the hydremic reaction was shown to various extents.

Thus, for instance, in the dog Belka, the maximum reduction of the dry residue after drinking was 7.5%, and when the fluid was given rectally it was 7.8%. In Diana, the corresponding figures were 11.2 and 13.6%. However, in some experiments in which the water was given rectally, the hydremic reaction was less well shown than when it was taken by mouth. It must be noted that the hydremic reaction which occurred in most of the experiments did not follow the course of the diuresis. In some cases when there was a hydremic reaction diuresis was increased, and again, when there was no hydremic response a copious diuresis occurred. These observations correspond with previous reports [12, 14].

Our investigations have threfore shown that the increased diuresis which follows the rectal intake of fluid occurs much later and is much less marked than when the fluid is given by mouth. It appears that in the first case the indefinite diuresis is caused by a slow absorption of fluid from the rectum. This conclusion is however contradicted by the results on the hydremic response following rectal water intake. Also, we carried out additional experiments in which fluid was withdrawn from the rectum by means of a rubber tube introduced through the sphincters. Five minutes after water had been introduced, no more than 25% of the volume given could be recovered, and after 15 minutes no fluid could be withdrawn. A few experiments were also carried out in which pure water was drunk instead of the mixture of water and milk. The normal well-developed water diuresis then occurred. This result showed that the increased diuresis following water taken by mouth was not due to its milk content.

Some experiments were performed in which water was given by mouth and a catheter introduced into the rectum for 15-20 minutes, in order to exclude any possible influence of this procedure on diuresis; it was found not to reduce the diuresis in any way. In order to prevent as far as possible any influence on urinary excretion from distention of the large intestine, as described by N. A. Myasoedova [9], we used fluid which had been warmed to body temperature, and introduced it slowly. It must also be remembered that in our experiments the rapid absorption of the fluid introduced reduced the stretching of the intestine, whereas in N. A. Myasoedova's experiments the dilatation of the rectum was continued for several hours.

M. L. Linetskii [7] also observed an indefinite diuresis after introducing fluid into the small intestine of

patients with a jejunostomy and V. F. Lysov [8] observed the same effect following a water load introduced through a fistula of the large intestine.

This study allows us to conclude that the reduced diuresis following water introduced rectally is due to the absence of stimulation of the normal receptive field concerned in reflex diuretic stimulation.

The results may have some practical importance. For example, when it becomes necessary to introduce fluid into the body, it is better to do so rectally, whereas in order to stimulate a powerful diuresis it should be given by mouth.

SUMMARY

Water given rectally to dogs with ureteric fistulae caused a much smaller diuresis than when the same quantity of fluid was given by mouth. Reabsorption was also decreased but to a smaller extent, while filtration remained unaltered. The hydremic reaction did not run parallel to diuresis whichever way the fluid was taken. The results obtained confirm the importance in water diuresis of reflex stimuli originating in the upper parts of the digestive tract.

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