

EFFERENT PATHS OF THE REFLEX GASTRIC INFLUENCES ON DIURESIS

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The mechanism of interoceptive influences from the stomach on diuresis has not yet received adequate study. The present communication aims at throwing some light on the results of series experiments on 5 dogs concerned with investigation of the efferent paths of the reflex gastric influence on diuresis.

METHODS

Three dogs (Pushok, Cherny, Khmury) were subjected to denervation of the right kidney, while one dog (Elma) was hypophysectomized. In all four animals the distal ends of the ureters were externalized in abdominal skin; all dogs had gastric fistulas. In the case of a fifth dog (Jack) also with a gastric fistula, the right kidney was transplanted into the cervical region and the distal end of its ureter externalized in the chest skin, while that of the left ureter was externalized in abdominal skin.

Gastric mechanoreceptors were stimulated by means of a thin-walled rubber balloon which was introduced into the stomach through the fistula and filled with varying amounts of water — 200-800 ml and over, warmed to 38°. The urine was collected separately from the two kidneys every 15 minutes.

In part of the experiments glomerular filtration and tubular reabsorption were determined by the endogenous creatinine method. In discussing the results those experiments in which the control value for blood creatinine clearance was not less than 2.3 ml per 1 kg body weight of the dog were taken into account. Creatinine clearance is then close to inulin clearance (M. Ladd, L. Liddle and A. Cagnon, 1956 [5]). In a number of cases the results of those experiments in which the control value of clearance was 2 to 2.3 ml per 1 kg body weight of dog were also considered reliable.

RESULTS

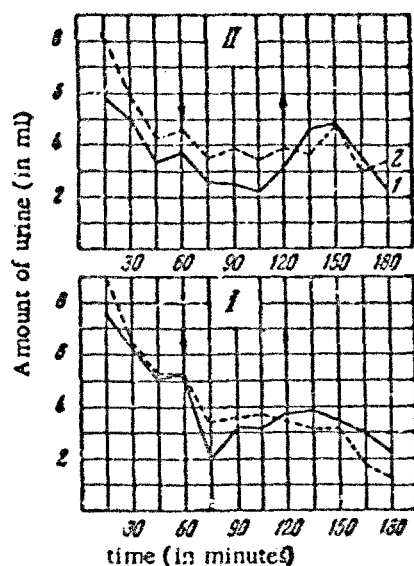
Distention of the stomach by means of the balloon produced in the dogs Pushok, Cherny and Khmury inhibition of urinary excretion both from the intact left and the denervated right kidneys. In the first few days following denervation less urinary inhibition was observed in the case of the right, denervated kidney in some experiments as compared with the intact left kidney. In subsequent experiments (after 10-14 days) all degrees of gastric distention, as a rule, elicited uniform inhibition of diuresis both of the intact and denervated kidney.

In view of the fact that the generally practiced technique of renal denervation could leave undamaged some nerve twigs and fibers running under vascular endothelium and along the ureter to the kidney it was decided to check the results of these experiments on the dog Jack, whose right kidney had been transplanted into the neck and the left one was intact.

The figure shows the results of two experiments on this dog. Distention of the stomach by introducing 800 ml water into the balloon caused definite inhibition of diuresis of the left, intact, kidney and had little effect on diuresis of the right, transplanted, kidney (D). On stronger stimulation of gastric mechanoreceptors (balloon

filled with 1000 ml water) diuresis of both kidneys was inhibited equally (10). Results given by other experiments on this dog were analogous. Distention of the stomach by increasing the volume of the balloon to 600 or 800 ml produced definite inhibition of diuresis of the intact left kidney and had little effect on diuresis of the intact left kidney and had little effect on diuresis of the transplanted right kidney. Marked distention of the stomach (1000 ml) gave rise to inhibition of diuresis of both kidneys.

Data of experiments on the dog Cherny are presented in the table (see Table); these data show that



Changes in diuresis in a dog with transplanted (1) and intact (2) kidney on stimulation of gastric mechanoreceptors.

↓ - beginning, ↑ - end of gastric distension by balloon. I and II different experiments.

during the distention of the stomach by means of the balloon reabsorption was growing in both kidneys. Filtration in the intact left kidney diminishes, while in the denervated right kidney it remains unchanged. Analogous results were noted in experiments on the dog Jack with the transplanted kidney (see Table). During distention of the stomach by the balloon reabsorption increases in both kidneys, filtration is diminished in the intact left kidney and increases a little in the right, transplanted, kidney.

Thus, urinary excretion in the intact kidney is diminished under the influence of gastric distention by virtue of increased reabsorption and decreased filtration. In the denervated or transplanted kidney diuresis can only diminish by virtue of increased reabsorption.

These data permit the assertion that with moderate stimulation of gastric mechanoreceptors the efferent arc of the reflex gastric influence on diuresis is made up of two paths: a neurohumoral one which regulates processes of reabsorption and a neural one which regulates processes of filtration. Impairment of the latter (denervation of the kidney) prevents a decrease of filtration on distension of the stomach by the balloon. These data coincide with the results of K. A. Dryagin's experiments [4] in

which he obtained analogous data by studying conditioned reflex influences on diuresis, and with the inferences drawn by K. M. Bykov [3] from the experiments of his collaborators. However, with very strong interoceptive stimuli diuresis of the denervated kidney can still be altered by virtue of diminution of filtration (experiment on the dog Pushok).

Changes of Glomerular Filtration and Tubular Reabsorption on Distention of the Stomach by a Balloon (Dog)

Dog	Nature of Exp.	Time in hrs	Filt. ml./min.		Water Reabsorp. (% Filt.)	
			rt. denerv. kidney	left intact kidney	rt. denerv. kidney	left intact kidney
Cherny (wt. 8,1 kg)	2nd hr. exp. stomach distended by 800 ml balloon.	1-st	8.017	9.412	96.18	95.98
		2-nd	8.235	7.455	97.80	97.51
		3-rd	8.457	7.832	95.70	95.98
Jack (wt. 18,5 kg)	2nd hr. exp. stomach distended by 1000 ml balloon vol.	1-st	11.972	25.980	97.90	98.64
		2-nd	15.411	19.701	99.78	99.44
		3-rd	15.939	21.303	99.27	99.36
Pushok (wt. 6,1 kg)	2nd hr. exp. stomach distended by 800 ml balloon	1-st	15.876	13.321	99.38	98.64
		2-nd	8.197	11.502	99.01	98.82
		3-rd	15.882	24.618	98.70	98.94

For a dog of small weight (6.5 kg) distention of the stomach by a balloon 800 ml in volume was very strong stimulation. During such distention motor agitation was noted. Diminution of diuresis was considerable and occurred by virtue of diminution of filtration in both kidneys. Taking the data of this experiment as a basis it may be postulated that with strong interoceptive stimuli new neurohumoral mechanisms are brought into play which cause marked diminution of filtration.

In view of the fact that many authors ascribe to the hypophysis a leading role in the neurohumoral chain in reflex influences on the kidneys [1, 4] it was decided to investigate the reflex gastric influences on diuresis in a dog which had been subjected to hypophysectomy. Following hypophysectomy (dog Elma) inhibition of diuresis only occurred in response to extremely strong interoceptive stimulation of the stomach. A very slight inhibition of diuresis could only be produced by distending the stomach by a balloon 1200 ml in volume. It would appear that removal of the hypophysis creates serious obstacles in the path of reflex gastric influences on diuresis.

SUMMARY

It was established in experiments on dogs with denervated kidneys, as well as with transplanted kidneys, that there are two routes by which stimulation of mechanoreceptors of the stomach takes place. The first is the nervous route, which regulates the processes of filtration, while the second is a neurohumoral route, regulating the processes of reabsorption. Very strong interoceptive stimulations of the stomach may result in decreased filtration in denervated kidneys. This shows the possibility of regulating the process of filtration by the neurohumoral route. Removal of the hypophysis hinders the reflex effect from the stomach on diuresis, which points to a definite role played by the hypophysis in the neurohumoral route of the efferent arch of the reflex from the stomach on diuresis.

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* In Russian.