EFFECT OF VASOPRESSIN AND PITUITRIN ON THE PAROTID AND SUBMANDIBULAR GLANDS

M. S. Yaremenko

UDC 612.313.4:612.434.018

Experiments on dogs showed that injection of pituitrin or vasopressin into the blood supply of the parotid and submandibular salivary glands causes a temporary (3-5 min) decrease in the rate of pilocarpine secretion of saliva and a more prolonged (10-20 min) increase in the concentration and absolute content of sodium and chloride in the saliva.

* * *

A previous investigation [1] showed that injection of small doses of posterior pituitary extract (pituitrin) into the blood supplying the parotid salivary gland in dogs causes a transient decrease in the rate of saliva secretion and an increase in the concentration and content of sodium in the saliva.

It was interesting to determine whether this action of pituitrin is limited to the parotid gland or whether it extends also to the submandibular salivary gland.

Pituitrin contains vasopressin and oxytocin. Injection of oxytocin into dogs causes no visible change in the secretory function of the parotid gland [1]. This suggested that the active principle of pituitrin is the hormone vasopressin.

In the present investigation the response of the parotid and submandibular salivary glands to pituitrin and vasopressin were therefore studied.

TABLE 1. Changes in Velocity of Pilocarpine Secretion of Saliva, in Concentration, and Content of Sodium and Potassium Ions in Saliva after Single Injection of Lysine-Vasopression into Blood Supply to Parotid and Submandibular Salivary Glands of Anesthetized Dogs in Dose of 2.5 Milliunits/kg (M ± t)

Index investigated	n	Parotid gland			Submandibular gland		
		Initial level	after injection of vasopressin		Initial level	after injection of vasopressin	
			5 min	10 min		5 min	10 min
V (in ml/5 min)	8	2,2±0,2	1,5±0,2	2,5±0,2	4,5±0,4	2,1±0,4	4,0±0,4
P		—	<0,01	>0,05	—	<0,001	>0,05
C_{Na} (in meq/liter)	8	51,6±6,7	71,4±6,6	72,2±6,9	50,5±6,9	68,5>3,8	61,2±4,9
P		—	<0,05	<0,05	—	<0,02	>0,05
Q_{Na} (in μeg/5 min)	8	113±14	108±10	178±17	227±30	144±14	243±28
P		—	>0,05	<0,01	—	<0,05	>0,05
C_K (in meq/liter)	8	4,4±0,6	3,9±0,3	3,4±0,4	4,1±0,5	4,0±0,5	3,5±0,5
P		—	>0,05	>0,05	—	>0,05	>0,05
Q_K (in μeq/5 min)	8	9,7±1,2	5,9±0,5	8,4±0,9	18,5±2,2	8,4±1,0	13,9±2,0
P		—	<0,01	>0,05	—	<0,001	<0,05

Note: V represents volume of saliva secreted during 5 min; C_{Na} and C_K concentration of sodium and potassium in saliva; Q_{Na} and Q_K contents of sodium and potassium secreted in saliva during 5 min; n number of determinations of each index; P significance of difference compared with initial level.

Department of Metabolism, A. A. Bogomolets' Institute of Physiology, Academy of Sciences of the Ukrainian SSR, Kiev. (Presented by Academician of the Academy of Medical Sciences of the USSR V. V. Zakusov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 68, No. 8, pp. 73-75, August, 1969. Original article submitted December 2, 1968.

TABLE 2. Changes in Velocity of Pilocarpine Secretion of Saliva and in Concentration and Absolute Content of Sodium, Potassium, and Chloride Ions in Saliva from Parotid and Submandibular Salivary Glands after Single Intravenous Injection of Pituitrin in Dose of 10 Milliunits/kg into Unanesthetized Dogs (M ± t)

Index investigated	n	Parotid gland			Submandibular gland		
		Initial level	pituitrin 5 min	pituitrin 10 min	Initial level	pituitrin 5 min	pituitrin 10 min
V (in ml/5 min)	8	1,5±0,1	0,9±0,05	1,6±0,1	2,8±0,2	2,2±0,1	2,5±0,2
P		—	<0,001	<0,5	—	<0,02	>0,05
C_{Na} (in meq/liter)	8	8,4±0,3	19,8±1,7	23,7±2,2	7,0±0,4	22,7±1,9	16,5±2,4
P		—	<0,001	<0,001	—	<0,001	<0,01
Q_{Na} (in μeq/5 min)	8	12,6±0,7	17,8±2,0	37,9±4,2	19,6±1,5	50,6±6,0	41,3±3,0
P		—	<0,05	<0,01	—	<0,001	<0,001
C_{Cl} (in meq/liter)	8	4,3±0,2	6,8±0,4	7,6±0,6	9,9±0,4	23,0±1,2	13,7±1,1
P		—	<0,001	<0,001	—	<0,001	<0,01
Q_{Cl} (in μeq/5 min)	8	6,5±0,3	6,1±0,2	12,2±1,6	27,7±1,4	50,6±2,6	34,3±2,9
P		—	>0,05	<0,01	—	<0,001	>0,05
C_K (in meq/liter)	8	7,2±0,5	6,9±0,6	5,4±0,4	6,5±0,5	6,3±0,5	6,1±0,5
P		—	>0,05	<0,001	—	>0,05	>0,05
Q_K (in μeq/5 min)	8	10,8±1,3	6,2±0,6	8,7±0,4	18,2±1,1	13,9±0,9	15,2±1,0
P		—	<0,001	<0,01	—	<0,001	>0,05

Note: C_{Cl} represents chloride concentration in saliva; Q_{Cl} absolute content of chloride secreted in saliva during 5 min. Remainder of legend as in Table 1.

EXPERIMENTAL METHOD

The first part of the investigation was carried out on 8 dogs anesthetized with chloralose (100 mg/kg) with the addition of nembutal (5 mg/kg) at the beginning of the experiment. Thin polyethylene catheters for collecting saliva were introduced through the orifices of the efferent ducts of the right parotid and submandibular salivary glands. Secretion of saliva was stimulated by intravenous infusion of isotonic dextrose solution with pilocarpine in a concentration of 25 mg/liter into the animals. The hormone lysine-vasopressin was diluted immediately before the experiment with isotonic dextrose solution, and then, when the level of saliva secretion was stabilized, 1 ml of this solution containing the hormone in a dose of 2.5 milliunits/kg body weight was injected into the right carotid artery. The second part of the investigation consisted of chronic experiments on 2 dogs with their parotid and submandibular salivary ducts exteriorized by Glinskii's method. Secretion of saliva was stimulated as in the preceding series of experiments. The reaction of the salivary glands was studied to a single intravenous injection of pituitrin into the animals in a dose of 10 milliunits/kg. Saliva was collected every minute before and after injection of vasopressin or pituitrin into the animals. The sodium and potassium concentrations were determined in each sample of saliva by flame photometry and chlorides by Rushnyak's method. Synthetic lysine-vasopressin used in the experiments was manufactured by the firm Spofa (Czechoslovakia) and pituitrin P by the Moscow Endocrine Factory.

EXPERIMENTAL RESULTS

The results of these investigations showed that injection of vasopressin into the right carotid artery produces simultaneous changes in secretory function of the right parotid and submandibular salivary glands, the response beginning 1 min after injection of the hormone. Vasopressin produced a very transient (for 3-5 min) decrease in the rate of saliva secretion both by the parotid and by the submandibular gland. Meanwhile the sodium concentration in the saliva of both glands began to increase. However, the increase of sodium concentration in the saliva of the submandibular gland reached a maximum during the first 5 min after injection of vasopressin, and then began to fall, while the high sodium concentration in saliva from the parotid gland continued for the second period of 5 min after injection of the hormone (Table 1). The potassium concentration in the saliva remained essentially unchanged after injection of vasopressin.

Injection of pituitrin into the animals also caused regular changes in secretory function of the parotid and submandibular salivary glands. Analysis of the results (Table 2) shows that pituitrin acts similarly to vasopressin on the parotid and submandibular glands. Injection of pituitrin into the general circulation of the animal caused a transient decrease in the rate of saliva secretion from both glands, and changes developed simultaneously in the electrolyte composition of saliva. Pituitrin, like vasopressin, had a longer

action on the parotid than on the submandibular gland. This is clear from comparison of the changes in sodium concentration in saliva from the parotid and submandibular glands after injection of pituitrin into the dogs. The absolute content of sodium and chloride in the saliva of the submandibular gland rose to a maximum, as did the concentration of these ions, during the first 5 min after injection of pituitrin into the animals, while these indices reached their maximum in saliva from the parotid gland during the second period of 5 min.

The potassium concentration in the saliva showed no significant change after injection of pituitrin. The absolute content of this ion in the saliva showed a more marked decrease.

It can be concluded from these investigations that both the parotid and submandibular salivary glands are sensitive to pituitrin and vasopressin. The action of vasopressin and pituitrin on the function of these glands is similar. Since oxytocin has no such action on the salivary glands [1], there is reason to suppose that the active principle of pituitrin is the hormone vasopressin.

The final concentration of sodium and chloride in saliva from the parotid and submandibular glands depends principally on the intensity of reabsorption of these ions by the cells of the salivary ducts [2-8]. The increase in content of sodium and chloride in the saliva after injection of pituitrin and vasopressin was possibly due to the inhibitory action of posterior pituitary hormones on reabsorption of sodium in the ducts. The possibility likewise is not ruled out that the increase in elimination of these ions with the saliva may take place as a result of an increase in the rate of passive diffusion of sodium and chloride from the extracellular fluid into the saliva through the wall of the ducts, the permeability of which may be increased by the action of pituitrin and vasopressin.

LITERATURE CITED

1. M. S. Yaremenko, Fiziol. Zh. SSSR, No. 8, 974 (1967).
2. S. W. Brusilow and R. E. Cooke, Am. J. Physiol., 196, 831 (1959).
3. B. L. Henriques, Am. J. Physiol., 201, 935 (1961).
4. H. Holzgreve, J. B. Martinez, and A. Vogel, Pflüg. Arch. Ges. Physiol., 290, 134 (1966).
5. L. L. Langly, C. H. Gunthorpe, and N. A. Beall, Am. J. Physiol., 195, 693 (1958).
6. L. L. Langly and R. S. Brown, Am. J. Physiol., 199, 59 (1960).
7. J. B. Martinez, H. Holzgreve, and A. Frick, Pflüg. Arch. Ges. Physiol., 290, 124 (1966).
8. J. H. Thaysen, N. A. Thorn, and I. L. Schwartz, Am. J. Physiol., 178, 155 (1954).