

SECRETORY AND STRUCTURAL DISTURBANCES IN THE GASTRIC MUCOSA AFTER ADRENALECTOMY

S. M. Lipovskii

UDC 616.33-018.73-091/-
092-02:616.45-089.87

After adrenalectomy (observations lasting 43 days) there is no decrease in the volume of gastric juice secreted, but the hydrochloric acid concentration falls (by 31-47% of its initial value). This was due to death and degenerative changes in the parietal cells of the fundal glands.

* * *

Several workers [4, 5, 7, 8] have observed disturbances of gastric secretion after adrenalectomy in rats, although information on the character of these disturbances is conflicting. Some investigators have described a decrease in the volume of gastric juice secreted, while others mention a lowering of its hydrochloric acid or pepsin concentration. The problem of the histological and histochemical changes taking place in the stomach after adrenalectomy has been insufficiently studied. It has been shown [2, 3, 6, 9] that the weight of the stomach is reduced in adrenalectomized rats, venous stasis develops, and atrophic changes, hemorrhages and ulceration take place in its mucous membrane. A decrease in the size of the principal cells has been found macroscopically.

A combined investigation* was carried out on male rats weighing 200-220 g to determine the dynamics of disturbances of gastric secretion and also the histological and histochemical changes taking place in the gastric mucosa after total adrenalectomy.

EXPERIMENTAL METHOD

Cannulas were introduced into the prepyloric part of the animals' stomach. The gastric juice was investigated (two or three times) 2-3 weeks after the operation to determine the initial parameters. The adrenals were then removed; after the operation the rats were kept on a normal diet but instead of water they received 1% NaCl solution. The volume of gastric juice secreted, the total acidity, the free HCl and pepsin concentration (by Tugolukov's method [1]) were estimated. Material for histological and histochemical investigation were taken from various parts of the stomach and fixed in formalin or by Shabadash's method. The samples were dehydrated and embedded in paraffin wax. Sections were stained with iron-hematoxylin and also by the methods of Feulgen, Brachet, and Hotchkiss. The experimental animals (62 rats) were divided into two groups. In the rats of group 1 (28 adrenalectomized, 6 undergoing mock adrenalectomy †, and 6 intact) the gastric secretion was studied. In the animals of group 2 (10 adrenalectomized, 6 undergoing mock adrenalectomy, and 6 intact) the gastric mucosa was investigated histologically and histochemically. Investigations on the adrenalectomized rats were resumed 8-10 days after the operation. The experiments were carried out weekly (3-6 weeks). The animals were fasted for 18 h before the experiment (salt solution was given ad lib.). Gastric juice was then collected for a period of 1 h.

*The histological and histochemical investigations were carried out jointly with N. M. Zhukova.

†For greater reliability, besides the control group (animals with cannulas in the stomach), additional investigations were made of animals undergoing a mock adrenalectomy, the operation being the same as in the adrenalectomized animals but the adrenals were not removed. These animals received 1% NaCl solution.

Laboratory of Gastroenterology, Academy of Medical Sciences of the USSR; Department of Pathological Physiology, Leningrad Sanitary-Hygienic Medical Institute (Presented by Academician V. N. Chernigovskii). Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 67, No. 5, pp. 25-27, May, 1969. Original article submitted March 31, 1967.

TABLE 1. Determination of Volume of Fasting Gastric Juice Secreted Per Hour and of Some of Its Components Under Normal Conditions and After Adrenalectomy

Animals investigated	Index	Volume of gastric juice (in ml)	Total acidity	Free hydrochloric acid	Pepsin content (in mg)	
					In 1 ml gastric juice	Total secreted
Intact	$M \pm m$ %	$1,9 \pm 0,1$ 100	$78,75 \pm 4,5$ 100	$43,3 \pm 3,5$ 100	$21,0 \pm 3,7$ 100	$43,5 \pm 7,8$ 100
8-10 days after adrenalectomy	$M \pm m$ % P	$1,86 \pm 0,3$ 97,9 >0,1	$39,7 \pm 9,3$ 54,1 <0,001	$22,7 \pm 7,1$ 53,7 <0,02	$7,3 \pm 0,8$ 34,8 <0,01	$14,9 \pm 3,4$ 34,2 <0,01
» 11-20 »	$M \pm m$ % P	$2,23 \pm 0,25$ 117,4 >0,1	$71,5 \pm 8,0$ 90,8 0,1	$41,5 \pm 6,6$ 98,1 >0,1	$22,3 \pm 1,0$ 106,2 0,1	$52,6 \pm 11,5$ 120,9 >0,1
» 21-43 »	$M \pm m$ % P	$3,42 \pm 0,38$ 180 <0,001	$73,0 \pm 5,3$ 92,7 >0,1	$29,5 \pm 4,3$ 69,7 <0,05	$16,0 \pm 1,5$ 76,2 >0,1	$53,0 \pm 8,2$ 121,8 >0,1

EXPERIMENTAL RESULTS

As Table 1 shows, 8-10 days after adrenalectomy there was practically no change in the volume of gastric juice secreted. On the other hand, the parameters of its ingredients showed a sharp decrease by this time. From the 11th to the 20th day after adrenalectomy, an almost complete and permanent normalization of pepsin secretion took place in most rats. So far as hydrochloric acid production is concerned, in this case compensation was relative and unstable; in the later periods the hydrochloric acid concentration fell again. This indicates considerable exhaustion of the secretory power of the parietal cells. The data described were confirmed by the results of histological examination, but there is good reason to suppose that the changes in secretory activity of the stomach resulted, not from the adrenalectomy, but from the prolonged action of NaCl solution on the gastric mucosa. For this reason, additional experiments were carried out on animals undergoing mock adrenalectomy but receiving 1% NaCl solution and on control rats receiving ordinary water. In the first group, the secretion of gastric juice was increased, and showed a constant tendency toward an increase in the free hydrochloric acid concentration, no decrease being found in its concentration in any of the animals. Hence, the results of these additional experiments suggest that adrenalectomy (and not the salt solution) was the cause of the decrease in hydrochloric acid production by the parietal cells.

At autopsy on many of the adrenalectomized rats, erosions and small ulcers were observed on the gastric mucosa microscopically on the 14th day after the operation. Histological and histochemical changes were found in all animals on the 6th day after operation. The most marked destruction was observed in the fundal part of the stomach. Proliferation of undifferentiated epithelium in the superficial part of the gastric mucosa was observed, as a result of which the necks of the glands became lengthened and the parietal cells were displaced into the deeper layers of the mucosa. The epithelium of the terminal portions of the glands was flattened. The quantity of cytoplasm in the cells was reduced. A deficiency of ribonucleic acid was discovered in the principal cells. Death and a decrease in size of the principal and parietal cells were found; the parietal cells were most severely affected; large numbers of vacuoles appeared in them, and pycnosis of their nuclei was found. In the animals undergoing mock adrenalectomy and receiving 1% NaCl solution no pathological changes were found in the stomach.

LITERATURE CITED

1. V. N. Tugolukov, Modern Methods of Determination of the Physiological State of the Gastric Mucosa and Their Clinical Importance [in Russian], Leningrad (1965).
2. A. Aschkenasy, Ann. Endocrinol. (Paris), 22, 993 (1961).
3. B. L. Baker and R. M. Bridgman, Am. J. Anat., 94, 303 (1954).
4. S. P. Bralow, S. A. Komarov, and H. Shay, Am. J. Physiol., 206, 1309 (1964).
5. R. Madden and H. Ramsburg, Endocrinology, 49, 82 (1951).
6. Masuda Kazuniko, J. Okayama Med. Ass., 71, 3551 (1959).

7. E. Tuerkischer and E. Wertheimer, J. Endocrinol., 4, 143 (1945).
8. R. Welbourn and C. Code, Gastroenterology, 23, 356 (1953).
9. R. B. Welbourn and J. T. Ward, Gastroenterology, 42, 784 (1962).