

Gastric Secretion of Iodide Related to Adrenocortical Activity

An Experimental Study in the Pylorus-Ligated Rat

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The effect of adrenalectomy and the administration of corticosteroids to adrenalectomized and sham-operated controls on the gastric secretion of iodide and hydrochloric acid were studied in a total of 210 albino rats during a 6-hour period after pyloric ligation. The volume, iodide content, and acidity of gastric contents were reduced significantly immediately after adrenalectomy. This effect was eliminated after 14 days. The iodide secretion was positively correlated to the volume of the gastric contents but not to their pH.

Key-words: Adrenal cortex hormones; adrenalectomy; gastric juice; iodides

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The gastric mucosa secretes iodide in concentrations up to 20-40 times the plasma concentration (5, 8, 11, 12, 13). Available evidence indicates that iodide secretion may be independent of the secretion of hydrochloric acid (2, 5, 7). Autoradiographic localization of radioiodide in the mucus-producing surface epithelial cells of the gastric mucosa also suggests this (9, 16, 17). The iodide-concentrating mechanism of the stomach, although similar to the iodide trap of the thyroid in some respects, seems to be independent of the secretion of TSH or thyroid function (1, 4, 9).

As no studies of the iodide secretion of the stomach in relation to adrenocortical activity have been reported, and unanimity is lacking on the adrenal influence on the secretion of hydrochloric acid (3), we found it of some interest to study these functions in the pylorus-ligated rat.

MATERIAL AND METHODS

A total of 210 male albino rats (Sprague-Dawley), from the same breeder, were used. They were kept on a diet of commercial pellets with an adequate content of calories, minerals, and vitamins.

The animals were divided into 10 groups of approximately 20 animals each (Table 1).

Operations were performed under open-drop ether anaesthesia. Bilateral adrenalectomy or sham operation was performed under sterile conditions with the animal in the prone position, through longitudinal incisions on both sides of the vertebral column, below the last rib. The sham operation consisted of corresponding incisions with exposure of the adrenal gland regions. At the end of the operation 10 ml isotonic dextrose in saline were deposited intraperitoneally.

Table I. Experimental groups

| | n | Weight in g Mean S.D. | ¹³¹ I% of dose. Mean value with 95% confi- dence limits | Volume Mean value with 95% confidence limits | pH. Mean value with 95% confidence limits |
|--|----|--------------------------|--|--|---|
| 1. Sham-operated controls | 20 | 266 ± 12.1 | 58.6 ± 7.4 | 6.1 ± 1.5 | 2.0 ± 0.29 |
| 2. Sham-operated controls + CA | 20 | 209 ± 5.8 | 56.2 ± 7.4 | 5.3 ± 1.5 | 1.7 ± 0.29 |
| 3. Sham-operated controls + Doca | 20 | 226 ± 10.7 | 56.1 ± 7.4 | 4.3 ± 1.5 | 1.9 ± 0.29 |
| 4. Sham-operated controls + P | 20 | 216 ± 13.4 | 50.2 ± 7.4 | 3.8 ± 1.5 | 2.2 ± 0.29 |
| 5. Sham-operated controls 6 hours | 20 | 245 ± 22.7 | 66.5 ± 7.4 | 11.0 ± 1.5 | 1.9 ± 0.29 |
| 6. Adrenalectomized 6 hours | 19 | 235 ± 23.9 | 51.0 ± 7.6 | 2.9 ± 1.5 | 2.8 ± 0.30 |
| 7. Adrenalectomized — no substitution | 20 | 221 ± 10.7 | 55.6 ± 7.4 | 5.8 ± 1.5 | 2.1 ± 0.29 |
| 8. Adrenalectomized — + CA | 21 | 216 ± 9.6 | 66.9 ± 7.2 | 8.5 ± 1.4 | 1.8 ± 0.28 |
| 9. Adrenalectomized — + Doca | 30 | 225 ± 9.3 | 48.2 ± 6.0 | 5.7 ± 1.2 | 2.2 ± 0.24 |
| 10. Adrenalectomized — + P | 20 | 230 ± 10.7 | 54.8 ± 7.4 | 4.5 ± 1.5 | 1.9 ± 0.29 |

CA – Cortisone acetate Doca – Desoxycorticosterone acetate P – Prednisolone

After 18 hours' fasting with free access to fluids, the animals were subjected to pyloric ligation (14) and sacrificed 6 hours later; the secretion recorded thus corresponded to 6 hours' secretion. A previously measured dose of radioiodide (2 μ Ci ¹³¹I Na) was injected into the right external jugular vein immediately after pyloric ligation. 10 ml of isotonic dextrose saline were administered subcutaneously at the beginning of the fasting period and repeated intraperitoneally at the end of pyloric ligation.

In groups 5 and 6 adrenalectomy or sham operation was performed through the abdominal cavity immediately before the pyloric ligation.

In the remaining groups the animals were kept in separate cages for 14 days after the adrenal procedure. For adrenalectomized animals the drinking water was replaced by isotonic saline. As indicated in the Table, the different groups of the animals were given

glucocorticoids or mineral corticoids subcutaneously on the 3 days prior to the analysis, in the following daily doses:

Cortisone acetate (Upjohn) - 10 mg

Prednisolone (Ultracortenol®, Ciba) - 2.5 mg

Desoxycorticosterone acetate (Percorten®, Ciba) - 2.5 mg.

After sacrificing the animal with ether the stomach was removed. Radioactivity in the stomach, as well as in the whole body, was recorded, the sum of the recordings corresponding to the dose administered. The value for the stomach is expressed in per cent of the dose administered. The volume and pH of the stomach contents were recorded (pH meter, Radiometer, Copenhagen).

Results were analysed by variance analysis, paired simultaneous comparisons between the groups (Scheffe), T-test, and regression analysis for correlation coefficient between the three parameters.

RESULTS

For pH, no significant difference was found between the groups. Significant differences were found, however, between the groups for percentage iodide ($p < 0.025$) and volume ($p < 0.005$) (Table 1).

Paired simultaneous comparisons between the groups gave significant differences at the 5 per cent level for percentage iodide between the groups 8 and 9 and for volume between groups 3 and 8 and groups 4 and 8.

Paired simultaneous comparisons with the T-test gave the following results:

| Groups | % iodide | volume | pH |
|--------|-------------|--------------|--------------|
| 5-6 | $p < 0.005$ | $p < 0.0005$ | $p < 0.0005$ |
| 1-5 | $p > 0.05$ | $p < 0.005$ | $p > 0.05$ |
| 6-7 | $p > 0.05$ | $p < 0.01$ | $p < 0.001$ |

No differences in volume, pH, or iodide secretion were found between the sham-operated control group, 1, and the corresponding steroid-treated groups, 2-4 (Fig. 1).

Fig. 1.

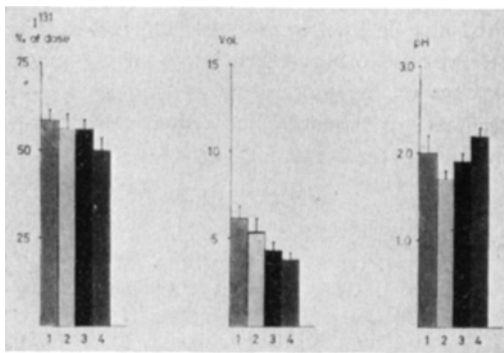


Fig. 2.

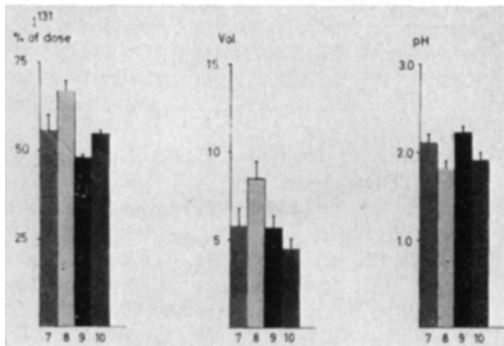


Fig. 3.

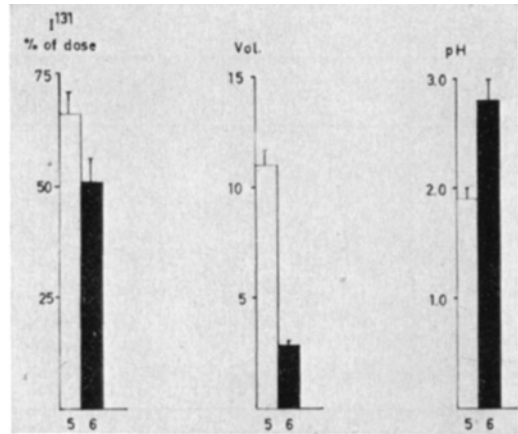


Fig. 4.

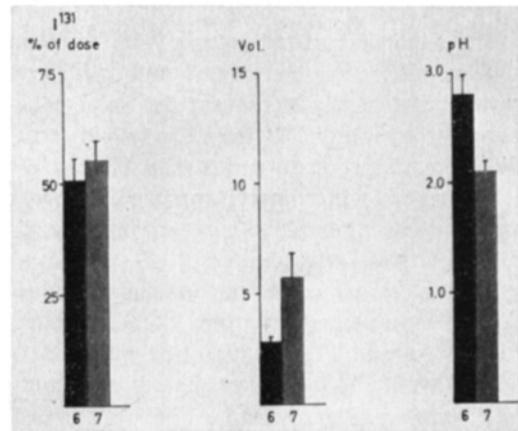
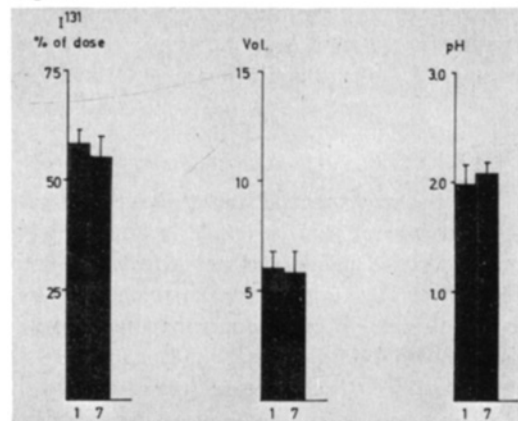


Fig. 5.



Figs. 1-5. Histograms representing the ^{131}I content (% of dose), volume (ml), and pH in the pylorus-ligated stomach in the ten defined experimental groups (indicated by numbers along the horizontal axis).

Table II. Correlation coefficient between % iodide and volume with *t*-values on testing of the hypothesis $r = 0$

| Experimental groups | <i>r</i> | <i>t</i> |
|---------------------|----------|----------|
| 1 | 0.87 | 7.62*** |
| 2 | 0.67 | 3.78** |
| 3 | 0.60 | 3.17** |
| 4 | 0.30 | 1.33 |
| 5 | 0.11 | 0.47 |
| 6 | 0.30 | 1.29 |
| 7 | 0.51 | 2.51* |
| 8 | 0.48 | 2.37* |
| 9 | 0.61 | 4.11*** |
| 10 | 0.69 | 4.05*** |

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The adrenalectomized groups, 7-10, however, showed differences in volume and iodide secretion, statistically significant for volume between groups 8 and 10 and for iodide secretion between groups 8 and 9 (Fig. 2).

No mutual differences appeared between steroid-treated groups with regard to adrenalectomy or sham operation.

Adrenalectomy caused an immediate reduction in volume, acidity, and iodide secretion (see T-test and Fig. 3) that had returned to normal within 14 days after the adrenalectomy (see T-test and Figs. 4 and 5).

Regression analysis showed no correlation between pH and the other parameters studied. Positive correlation was, however, found between volume and iodide content (Table II).

DISCUSSION

Under the experimental set-up described, gastric secretion of acid or iodide in animals with intact adrenal glands was not affected by any of the steroids administered, which with regard to acid secretion confirms the observations of Welbourn & Code (18) and Kyle & Welbourn (6). The increase in secretion volume and iodide content caused by cortison-acetate in the adrenalectomized animal is difficult to interpret in this context.

The immediate reduction in acid secretion after adrenalectomy demonstrated here is in

agreement with previous observations (10, 15). The return to normal of acid secretion 14 days after adrenalectomy contradicts earlier observations of Welbourn & Code (18). Differences in experimental conditions may be the probable explanation of the different results.

The dependence of gastric secretion of iodide on the adrenal cortex has not been analysed previously. The present study demonstrates such a dependence, adrenalectomy causing an immediate reduction, together with a reduction in volume and acidity of the gastric contents. The iodide secretion returns towards control level within 14 days after the adrenalectomy, as do volume and acidity, cortisone acetate causing a further increase over control level.

It is furthermore evident from the present study that iodide secretion is positively correlated to secretion volume but not to its acidity. This finding is in agreement with earlier observations indicating that hydrochloric acid and iodide secretions may be independent functions (5). The variation in iodide secretion correlating with change in secretion volume, but not hydrochloric acid secretion, may thus reflect the influence of adrenal cortical hormones on the blood circulation of the gastric mucosa or the outpouring of non-parietal secretions independent of any direct adrenal cortical effect on the parietal cells.

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