Effect of Bilateral Adrenalectomy and Parenteral Betamethasone on Gastric Mucosal Mast Cell Population in Albino Rats

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Summary. The histamine-laden mast cells of gastric mucosa in albino rats are shown to degranulate on administration of Betamethasone, but they increase in number in adrenalectomized rats. It is concluded that Betamethasone, and also adrenal glucocorticoids increase gastric secretion by liberating histamine from mast cells and histamine in turn acts on the gastric glands.

Glucocorticoids, exogenous and endogenous, are well-known stimulants of gastric secretion either by their permissive action or selective conditioning of the gastric glands[1] to specific gastric stimulants like histamine, acetylcholine and others. On the other hand, bilateral adrenalectomy reduces profoundly the level of gastric secretion[2]. Our observation shows that bilateral adrenalectomy reduces the ulcer index of restrained rats to a very low level, possibly by reduction in gastric secretion[3]. The mechanism of adrenal-gastric inter-relationship is not well understood.

Histamine is a well-established and potent stimulant of gastric secretion and histamine liberators are known to act by releasing histamine from mast cells[4]. SELYE[5] demonstrated that pretreatment with stressors or cortisol in rats inhibits the production of haemorrhagic, oedematous lesions in gastric mucosa by the potent histamine liberator 48/80. FELDBERG et al.[6] ascribed this finding to the depletion of local histamine by stressors or cortisol.

The gastric mucosa of rat and other experimental animals, and man, abounds in mast cells which are shown to degranulate on long term ACTH therapy. Once these histamine-laden cells degranulate they lose their metachromasia and hence get reduced in number[7]. From these data, it is legitimate to postulate that adrenals and their steroids are concerned with the liberation of endogenous histamine from mucosal mast cells and thereby exert their gastric secretogogue action. The present experiment is therefore planned to study the effect of bilateral adrenalectomy and that of parenterally administered synthetic glucocorticoid, betamethasone, on gastric mucosal mast cell population in albino rats.

Materials and methods. 45 healthy albino rats of either sex, weighing between 100 and 150 g and housed in separate cages, are divided into 4 groups of 10, 15, 10 and 10 rats respectively.

Group I served as the control. Food and water were given ad libitum for 4 days. Solids were withheld on the 5th day. The animals were sacrificed on the 6th day and their stomachs were removed for histological processing. Group II rats were subjected to bilateral adrenalectomy by the method of Venning. All the rats were maintained on food and saline ad libitum. 10 of the 15 rats were sacrificed on the 6th post-operative day while the remaining 5 (group IIa) were sacrificed on the 15th day, solids being withheld for 24 hours prior to the killing in every case. The stomachs were removed for histo-technique. Group III rats received 1 i.m. injection per day of 0.5 mg betamethasone (Betnesol 4 mg/ml ampoule – GLAXO) for 5 days. Otherwise the procedure remained the same as in Group I. Group IV rats were subjected to bilateral adrenalectomy as for Group II followed immediately by an injection schedule as in Group III. The maintenance of the animals and the processing of the stomach were the same as in Group III.

The stomachs removed in each case were split along the greater curvature and fixed in 4% aqueous solution of basic lead acetate for 48 h. Routine histological procedures were followed and 10 µm thick sections were made from glandular, pyloric and ruminal regions of the stomach for every specimen. The sections were stained in 1% aqueous solution of Toluidine blue for 1 min. The mast cells in the mucosal layer could be readily identified by their metachromatic purple stain against the bluish background. A calibrated ocular micrometer was introduced into the eye-piece of the microscope and the mast cells were counted under high-power objective and expressed for 1 mm^2 of the gastric mucosa.

[1] H. SELYE, J. clin. Endocr. *14*, 122 (1954).
[2] S. J. GRAY and C. G. RAMSEY, Recent. Progr. Horm. Res. *13*, 583 (1957).
[3] A. K. GANGULY and O. P. BHATNAGAR, Can. J. Physiol. Pharmac. *51*, 748 (1973).
[4] C. F. CODE, Fedn. Proc. *24*, 1311 (1965).
[5] H. SELYE, P. JEAN and M. CANTIN, Proc. Soc. exp. Biol. Med. *103*, 444 (1960).
[6] W. FELDBERG and J. TALESNIK, J. Physiol., Lond. *120*, 550 (1953).
[7] T. RASANEN, Acta, path. microbiol. scand. Suppl. *129* (1958).

Table I. Effect of bilateral adrenalectomy on gastric mucosal mast cell population (MCP) in albino rats

Region of stomach	Mean MCP ± SE			*p*-Values		
	Group-I Control (10)	Group-II Adrenalectomy (10)	Group-IIa Adrenalectomy (5)	I–II	I–IIa	II–IIa
Glandular	255±7	397±15	448±14	<0.001	<0.001	0.05
Pyloric	118±4	154± 9	194± 5	0.001	<0.001	0.02
Rumen	56±3	113± 7	138± 4	<0.001	<0.001	0.04

Figures in parentheses denote the number of rats

Table II. Effect of bethamethasone on gastric mucosal mast cell population (MCP)

Region of stomach	Mean MCP ± SE			p-Values		
	Group-I Control (10)	Group-III Adrenal intact rats with steroid (10)	Group IV Adrenalectomized rats with steroid (10)	I–III	I–IV	III–IV
Glandular	255±7	138±6	228±7	<0.001	0.01	<0.001
Pyloric	118±4	82±4	114±6	<0.001	0.6	<0.001
Rumen	56±3	43±3	47±4	0.01	0.1	0.6

Figures in parentheses denote the number of rats

Results. Table I shows that bilateral adrenalectomy has produced a highly significant (p 0.001 or less) increase in the gastric mucosal mast cell population, irrespective of the region of the stomach and the interval after adrenalectomy – 5 or 15 days. Extension of the post-operative period to 15 days has not increased the number of mast cells in any part of the stomach (p 0.02 or more). Table II shows that betamethasone has reduced the mast cell population in adrenal intact rats in comparison with the control rats; the decrease being significant in all the 3 portions of stomach. On the other hand, the mast cell population in bilaterally adrenalectomized group, which received betamethasone, is almost the same as that of the control group.

Discussion. A good correlation has been shown between histamine, mast cells and parietal cells in all the zones of the stomach of rats, normal and cortisone treated, by FOLEY and GLICK[8]. They concluded that histamine was probably liberated from the mast cells when they underwent degranulation in response to appropriate stimuli. The increase in number of mast cells in adrenalectomized animals indicates that in the absence of the circulating steroids the histamine stays bound within the mast cells. Adrenalectomy may thus remove a potent stimulus for degranulation of mast cells as compared with adrenal-intact rats. The consequent lack of histamine release in the gastric mucosa can well explain the gastric anacidity reported in Addison's disease and adrenalectomized animals. The lack of a significant increase in the mast cell population on extension of the post-operative period shows that adrenals have a definite time-limited influence on the turn-over of gastric mucosal mast cells. The significant decrease in the number of mast cells in the betamethasone-treated normal rats is probably due to degranulation of mast cells by the steroid. The results also indicate that this effect is inhibited in adrenalectomized rats.

It is logical to conclude from these observations that betamethasone and likewise adrenal glucocorticoids can liberate histamine from the gastric mucosal mast cells and histamine in its turn stimulates the gastric glands, particularly the parietal cells.

[8] W. A. FOLEY and D. GLICK, Gastroenterology *43*, 425 (1962).

Effect of Exogenous Application of Nucleic Acids and Auxin on the Rooting of Hypocotyl Cuttings of *Impatiens balsamina*. Evidence for the Uptake of Information Molecules

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Summary. Exogenously supplied DNA and RNA hastened root initiation and also increased the formation of roots on hypocotyl cuttings of *Impatiens balsamina* with intact apex and cotyledons. IAA appreciably increased the nucleic acid-caused enhancement in root formation. In combination with lower concentrations of nucleic acids, it even stimulated the growth of roots as well as of hypocotyls. Higher concentrations of nucleic acids were, however, toxic.

JAIN and NANDA[2] and NANDA et al.[3] have shown that the auxin-caused increase in the production of adventitious roots involves the synthesis of proteins, and that this effect is mediated through the multiplication of either DNA or RNAs or both. Auxins are also reported to induce the formation of new species of m- or t-RNAs during the initiation and development of roots[4] (also unpublished data). Investigations were undertaken in this laboratory to study the interaction effect of auxin with nitrogen bases and also with their nucleosides and nucleotides on the formation of adventitious roots. It was considered that it will shed some light on the molecular basis of auxin effect on this morphogenetic event. This paper deals with the effect of nucleic acids on the rooting of hypocotyl cuttings of *Impatiens balsamina*.

Seedlings of *Impatiens balsamina* var. Rose were raised from uniform seeds. Four cm long cuttings were made from the seedlings by excizing about the lower 1.0 cm rooted part and leaving behind 3.0 cm hypocotyl, the cotyledons and the apex intact. 240 such cuttings were

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[2] M. K. JAIN and K. K. NANDA, Physiologia Pl. *27*, 169 (1972).

[3] K. K. NANDA, M. K. JAIN and N. C. BHATTACHARYA, Biologia Pl. *15* 412 (1973).

[4] K. K. NANDA and N. C. BHATTACHARYA, Biochem. Physiol. Pflanzen *164*, 632 (1973).