Effect of cerebellar modulation on rat gastric secretion and enterochromaffin-like cell

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Effect of cerebellar lesion and vestibular stimulation (VS) on the activity and alternation of ECL-cells along with changes in gastric volume and acid secretion was studied. The results suggest that cerebellar lesion caused increased gastric volume and acid secretion and tended to decrease ECL-cell density. On the other hand VS of nodular lesioned rats resulted in decrease of above parameter which became marked only after 21 days of nodular lesion.

Gastric mucosa is rich in endocrine cells among which the enterochromaffin-like (ECL) cells predominate. ECL-cell density is known to increase after long-term hypergastrinemia of endogenous origin induced by acid blockade or antrum exclusion and to decrease following antrectomy. The primary function of ECL-cell is the production of histamine, which in turn, stimulates parietal cells via H2-histamine receptors to secrete acid into gastric lumen. In acid inhibition, gastrin level in serum increase and ECL-cell proliferation continuous in a linear fashion.

The areas of the brain of interest in the control of gastric secretion are hypothalamus and certain areas lying between the diencephalon and cerebral cortex. Lesions of the posterior cerebellum in animals leads to gastric pathology and electrical stimulation of the fastigial area alters gastric secretory responses with changes in mucous substance secretion. The present study has been undertaken to observe whether there are any significant change in ECL-cells number and gastric acidity following cerebellar manipulation.

Pure bred Holtzman strain albino adult male rats (180-200g) were used. Food but not water was withheld 18 hr before experimentation. The animals were divided into following 4 groups of 20 rats each, a) control; b) rats given nodular lesion (NL); c) rats subjected to vestibular stimulatin (VS); and (d) rats given NL and subjected to VS also. All animals were implanted with stainless steel permanent gastric cannula for collecting gastric secretion under anaesthesia following 18 hr fasting.

Chemoleision of cerebellum—Chemoleision of cerebellar nodule was done stereotaxically following the co-ordinates of stereotaxic atlas of the rat brain by microinjection of kainic acid (0.2 μg) under sodium pentobarbital (40 mg/kg body wt) anaesthesia.

Routine antibiotic measures by injection of penicillin (10,000 units) were taken in all the groups till they recovered from surgical stress.

Vestibular stimulation (VS)—Animals were subjected to VS in a perpex rotating drum (24x15 cm; rotation speed: 18 rpm) at an angular acceleration of 100°/sec through a kymographic motor. The rotation of the drum was so adjusted that both clockwise and anticlockwise rotation consisted of successive 10 spins with angular acceleration being achieved in 1 sec, followed by constant velocity with an impulsive stop for 1 min. VS by rotation in a drum is considered to be a natural stimulation of the vestibular system which can reflexly modulate the cerebellar function.

The gastric juice under different experimental conditions collected, was measured and analysed for acidity. Total acid was determined by titration with 0.01 N sodium hydroxide against phenolphthalein as indicator.

Histological evaluation (Light microscopy)—After the termination of the experiment, the animals were sacrificed with a lethal dose of sodium pentobarbital. Stomach tissues were processed for routine histological analysis to visualize ECL cells following the method of Giemsa. Cerebellum was fixed in...
10% formalin and eosin-haematoxylin stained tissue was used for histology to confirm lesion site.

Statistical analysis—Student’s unpaired t test was applied.

The results are presented in Table 1 and Figs 1-3.

The lesion of cerebellar nodule caused hyperacidity along with decreased ECL-cell density. ECL-cells form major endocrine cell population in oxyntic mucosa. The data corroborates the work of others who showed that administration of increasing doses of acid secretion inhibitors to rat caused a hyperplasia of ECL-cells.

Vestibular stimulation when given to nodular cerebellar lesioned animals decreased or tended to decrease gastric juice volume and acidity but increased the number of ECL cell count. This supports previous observations that the cerebellum is involved in the gastric secretory function through modulating the vagal system by influencing either hypothalamo-limbic or other direct pathways to vagal centers.

Histological examination of the cerebellar nodule of lesioned animals revealed loss of Purkinje cells and clumping of the nucleus of the granular cell (Fig.3). Histamine producing ECL-cells play an integrative role in regulation of acid secretion. The present results indicated that ECL-cells count were increased in nodular lesioned group with an increase in gastric acidity but decreased by VS. The flocculonodular lobe of the cerebellum is closely

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**Fig. 1**—Enterochromaffin-like (ECL) cell density in stomach of rats. Values are mean ± SE. *P* values: *<0.01 and **<0.05 when compared with control; and †<0.01 and ‡<0.001 when compared with nodular lesion group

**Fig. 2**—Normal histological structure of the cerebellar molecular, Purkinje and granular cell layer. The Purkinje cell layer shows the intact Purkinje cells (arrows) HE stain × 2000

**Fig. 3**—Kainate lesioned change of the cellular pattern, loss of Purkinje cells layer (arrows) HE stain × 2000
related to vestibular apparatus. Rotational movement involving angular acceleration excites the vestibulo-cerebellum by activating the vestibular nucleus to semicircular canals. Lesion of the cerebellum caused imbalance which is a malfunction of the vestibular nuclei. VS is considered to be a natural therapy which may be useful in the treatment of gastric pathology.

### References