DETERMINATION OF THE ULCERATIVE POWER OF GASTRIC JUICE

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Rats were starved for 48 h, ligatures applied to the cardia and pylorus of the stomach, and 2-ml samples of the gastric juice to be tested, the pH of which ranged from 1 to 5, were injected into the stomach. The appearance of erosions, ulcers, and other pathological manifestations (edema, hemorrhage, maceration of the mucous membrane) was observed after 18 h. A parallel investigation of the gastric juice of normal animals and persons, the gastric juice of animals and persons with gastric ulcer, and solutions of hydrochloric acid of the corresponding pH values enabled the aggressiveness of the tested gastric juice to be compared and correlated with its proteolytic activity.

The essential role of changes in the acid-forming and enzyme-secreting functions of the stomach in the end-mechanisms of development of peptic ulcer is now firmly established. The role of gastric secretion in the onset of experimental atophan gastric ulcer has been convincingly demonstrated by Malkiman [2, 3]. Great importance is attached to the continuous secretion of hydrochloric acid as a factor causing ulceration of the gastric mucous membrane [1]. Evidence to show the role of gastric enzymes in this process has been obtained [4, 16, 17]. However, there is no precise information on the character of the changes taking place in the composition of the gastric enzymes and leading to ulceration of the mucous membrane of this organ.

The gastric juice of healthy persons and animals possesses two maxima of proteolytic activity at different pH values [5-12, 14]. Taylor [12-15] found three maxima of proteolytic activity of the gastric juice in peptic ulcer patients, corresponding to the following pH values: 1.5-2.1, 2.5-3.1, and 3.3-3.9. The possibility is not ruled out that the regular appearance of a third maximum of proteolytic activity may have a specific connection with ulceration of the gastric mucous membrane. To investigate this problem, a method was developed for determining the aggressiveness of the gastric juice.

Male rats of approximately equal weight in each series of experiments were used as the test objects to study the action of gastric juice. The animals were starved for 48 h, and under pentobarbital anesthesia (30 mg/kg, intraperitoneally) laparotomy was performed and ligatures applied to the pylorus and cardia of the stomach. By means of a syringe, 2 ml of the test gastric juice was then injected into the rat's stomach and the abdomen sutured without drainage. A further laparotomy was performed 18 h later, and the stomach was removed and opened along the greater curvature. The mucous membrane was examined visually and under a stereoscopic microscope, and its condition was determed with reference to the presence of edema, hemorrhage, maceration, erosions, and ulcers, noting their number, size, depth, and location.

A parallel series of control experiments was performed in which hydrochloric acid solutions of the same pH values were injected into the rats' stomach, and in other experiments ligatures were applied, but no solution was injected into the stomach.

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The time during which the rats were starved before the experiment (48 h) and the time during which the gastric juice was allowed to act on the rats' gastric mucous membrane (18 h) were determined experimentally as the optimal for the conditions of this particular investigation.

Parallel tests of the gastric juice of healthy animals or persons and of those affected by gastric ulcer, varying in pH from 1 to 5, enabled the aggressiveness of the normal and experimental gastric juices to be compared and the role of proteolytic activity at a given pH value in the development of ulceration of the gastric mucous membrane to be studied.

An essential condition to be observed when preparing a series of samples of the same gastric juice was that each sample should contain an equal amount of the original gastric juice (1 or 1.5 ml) at different pH values (from 1 to 5) and that its total volume should be equal (2 ml). This condition was satisfied by using 0.2 M sodium acetate buffer and hydrochloric acid solution of the corresponding pH value.

In experiments carried out jointly with Fernandes-Costa using this method, the aggressiveness of the gastric juice of dogs with experimental atophan gastric ulcer was tested. These experiments showed that the ulcerative power of the gastric juice of these dogs was very considerably higher than that of the gastric juice of normal dogs. A highly significant fact was that the ulcerative power of this juice reached a maximum at pH 4, which is where the third maximum of proteolytic activity appeared in these dogs, just as in patients with gastric ulcer [12-15].

It can accordingly be concluded that the ulcerative power of the gastric juice of dogs with atophan ulcer is associated with enzymic changes in the gastric juice of these dogs. These results will be described more fully in a joint communication.

LITERATURE CITED

1. E. Yu. Linar, The Acid-Forming Function of the Stomach under Normal and Pathological Conditions [in Russian], Riga (1968).
2. I. V. Malkiman and E. A. Rudik, Arkh. Pat., No. 1, 31 (1955).
3. I. V. Malkiman, in: Problems in the Physiology and Pathology of Digestion [in Russian], Moscow (1958), p. 57.
4. A. P. Nesterova, T. A. Solov'eva, P. M. Ginodman, et al., Vopr. Med. Khimii, No. 4, 408 (1967).
5. E. Freudenberg, Enzymologia, 8, 385 (1940).
6. R. Merten and H. Ratzer, Klin. Wschr., 27, 587 (1949).
7. G. Milhaud and Y. Epiney, Gastroenterologia (Basel), 77, 193 (1951).
8. W. Penitschka, Arch. Klin. Chir., 273, 904 (1953).
9. H. Pfisterer, Arch. Klin. Chir., 280, 123 (1955).
10. C. Pope and M. Stevens, Brit. J. Exp. Path., 32, 314 (1951).
11. Z. Ramer, Hoppe-Seylers Z. Physiol. Chem., 296, 73 (1954).
12. W. H. Taylor, Biochem. J., 71, 73 (1959).
13. W. H. Taylor, Gastroenterology, 40, 823 (1961).
14. W. H. Taylor, Physiol. Rev., 42, 520 (1962).
15. W. H. Taylor, Biochem. J., 113, 663 (1969).
16. W. H. Taylor, Nature, 227, 76 (1970).
17. D. S. Zimmon, G. Miller, G. Cox, et al., Gastroenterology, 56, 19 (1969).