Use of the software makes it possible to examine gastrointestinal patients in a comprehensive modern way and to recommend individual preventive, remedial, and rehabilitative measures.

LITERATURE CITED


A DEVICE FOR INTRAGASTRIC pH AND IMPEDANCE MEASUREMENTS

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A device for simultaneous measurement of intragastric pH and impedance using a special combined gastric probe has been developed to study acid secretion function and morphological status of the mucosa of the stomach [1, 2].

The need for such a device arises because, in spite of the high accuracy of presently used methods for intragastric pH determination, this method is not sufficiently reliable for study of acid secretion function of the stomach. This is due to the fact that the pH sensor registers hydrochloric acid in a limited area (parietally) and does not sufficiently reflect the status of the entire compartment of the stomach responsible for acid secretion [3].

This is particularly true for local atrophic gastritis, when intact portions of the mucosa may continue to secrete normal concentrations of hydrochloric acid which are registered by a pH sensor, whereas the total acid secretion of the stomach may already be significantly decreased [9].

The ionic electrical conductance of the mucosa of the stomach is determined by the secretion of its glands: the electrical resistance of the mucosa decreases with an increase in the number of glands and with increase in their secretion. As a dystrophic process of the mucosa develops, its electrical conductance decreases, i.e. the impedance increases.

The acid secretion function of the stomach is mainly performed by its corpus. The electrical conductance of the corpus mucosa is largely dependent upon the number and functional and morphological state of the main glands responsible for secretion of hydrochloric acid. The dissociated hydrogen ions of the acid are the most mobile and make the greatest contribution to the electrical conductance.

When glands are damaged, atrophied, or substituted by connective tissue, the electrical conductance decreases and impedance increases.

Any increase in impedance of the corpus of the stomach is therefore an indication of morphological changes in the given area, even though a pH sensor registers normal or increased concentrations of hydrogen ions in a limited area of the mucosa.

The combined device for intragastric pH and impedance measurement allows simultaneous registration of parietal intragastric acidity in the corpus of the stomach and measurement of the extent of acid neutralization in the antral segment and of total electrical resistance (impedance) throughout the entire stomach [7, 10].

The measurement of impedance is made at two frequencies, 10 and 200 kHz, to determine the contribution of the capacitance component of the resistance of tissues and cells in impedance and thus to characterize the morphological structure of the mucosa of the stomach [11].

The device consists of a combined gastric probe, a unit for measuring pH and impedance, a display, and recording unit (N3020-3 recorder).

The combined gastric probe includes two main antimony pH electrodes, one reference calomel pH electrode, and seven cylindrical impedance electrodes coated with palladium.

A block diagram of the device is shown in Fig. 1.

The channel for impedance measurement is made up of generator (1) with electrical switching of frequency (10 or 200 kHz), commutator (2) for impedance measuring electrodes of combined gastric probe (3) with pairwise sequential switching of the electrodes, preamplifier (4), amplitude detector (5), integrating amplifier (6), ADC (7), three-digit digital indicator (8), needle indicator (11), matching device (driver) (12), and recorder (13). The impedance readings in digital form in the range between 0 and 999 Ω are output through connector (9) to a digital indicator or computer.

Impedance calibrator (14) provides for testing the entire impedance channel using standard resistances ranging from 0 to 200 Ω in 10 Ω steps. Generator (1) produces at the output a continuous sinusoidal current with a frequency of 10 or 200 kHz and amplitude of about 50-100 μA which does not irritate the mucosa of the stomach but provides stable impedance measurements immune to noise and interference.

To exclude the influence of the impedance circuit on the pH measuring circuit, they are galvanically isolated from each other.

Impedance of different areas of the stomach is sequentially recorded by one channel of the recorder. The recording at frequencies of 10 and 200 kHz is performed with different recorder sensitivity made possible by the input of an additional alternating voltage to the deflecting system of the recorder [6].

The acidity is measured in pH units by the pH electrodes of the combined gastric probe (3), the signals from which are carried to corresponding high-impedance input (field-effect transistor) amplifiers (15) and (16) and then to functional units (17) and (18).

The special functional devices are required for the measurement of gastric acidity because only a rather narrow range of the pH scale, from 0.8 to 2.0, is diagnostically significant; this pH range corresponds to the usual values of free hydrochloric acid in gastric juice, from 160 to 10 mmole/liter (titration units).

The nonlinear functional units transform the pH scale so that the initial portion of the scale (to pH 2.0) increases approximately two fold. Such broadening significantly increases the accuracy of measurement of intragastric acidity.