Comparative Study of Hydrogen and Aminopyrine Clearance Methods for Determination of Gastric Mucosal Blood Flow in Dogs

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Effects of pentagastrin, histamine, PGI₂, and vasopressin on gastric mucosal blood flow (GMBF) in innervated stomachs of anesthetized dogs were measured by means of the hydrogen clearance method, using a contact electrode. The results were compared with findings obtained with the aminopyrine (AP) clearance method in Heidenhain pouch preparations. Pentagastrin at 2 and 8 µg/kg/hr had no effects on GMBF, as measured by the hydrogen clearance method, but there was a marked increase in GMBF when the AP clearance method was used. Histamine at 40 or 160 µg/kg/hr tended to reduce or significantly reduced GMBF when measured with the hydrogen clearance method, but there was a significant increase in GMBF with the AP clearance method. Both PGI₂ (3 or 30 µg/kg/hr) and vasopressin (0.06 or 0.25 units/kg/hr) reduced GMBF as determined by both methods. These results indicate that the hydrogen clearance method is advantageous for detecting regional GMBF but is disadvantageous when attempting to detect the effects of agents which increase GMBF.

Murakami et al (1) have recently reported that regional gastric mucosal blood flow (GMBF) in animals and humans could be readily measured by placing an electrode in contact with the gastric mucosa for detection of the clearance of hydrogen gas inhaled. They discussed the validity of the method by comparing the results with those obtained with the aminopyrine (AP) clearance method. The degree of the increase in GMBF in rats treated with pentagastrin and isoproterenol was much the same with either method. However, the effects of agents which lower GMBF were not given attention. We attempted to determine whether changes of GMBF in dogs in response to pentagastrin, histamine, PGI₂, or vasopressin were also detectable by the hydrogen clearance method, and the findings were compared with the data obtained using the AP clearance method.

MATERIALS AND METHODS

Hydrogen Clearance Method. Eight mongrel dogs of both sexes (7–18 kg) were deprived of food for 18 hr but allowed free access to water. All these animals were anesthetized with pentobarbital Na (Pitman-Moore, 30 mg/kg), given intraperitoneally, as required throughout the experiments. The forepaw vein was cannulated for continuous infusion of saline or test agents. According to the method of Murakami et al (1), a spring-shaped electrode (Unique-Medical) was introduced into the stomach through the channel orifice of an endoscope (Olympus, type D4), and the tip of the electrode was allowed to make contact with the mucosal surface of the corpus, along the
greater curvature (Figures 1 and 2). A calomel reference electrode was attached to the skin of the thorax. Tissue saturation with hydrogen gas was achieved by allowing the dogs to breathe under an inverted funnel (5 cm diameter) positioned about 2 cm above the nose. Pure hydrogen gas was supplied to the funnel at a rate of 0.5 liters/min. Inhalation was interrupted by removing the funnel within 30 sec when a sharp rise in current was observed. The current increased for a short period of time, peaked, and then declined. The declining portion of the curve was plotted semilogarithmically at 15-min intervals, and the GMBF was calculated as described by Murakami et al (1).

The measurement of GMBF in the control periods was repeated five times by reapplication of hydrogen gas when the previous recording returned to near zero and the mean value was calculated. Either pentagastrin (Sumitomo, 2 or 8 μg/kg/hr), histamine 2 HCl (Nakarai, 40 or 160 μg/kg/hr), or vasopressin (Sigma, 0.06 or 0.25 units/kg/hr), dissolved in saline, or saline alone, was then given intravenously at a rate of 5.5 ml/hr by means of a peristaltic pump (Harvard Apparatus) for 2 hr. PGI2 (Ono, 3 or 30 μg/kg/hr), dissolved in 1 M Tris buffer (pH 9.3), stored in ice and diluted with ice-cold sodium bicarbonate (1.25% w/v, pH 8.6) immediately before use, was infused at the same rate as the above agents. The