**Helicobacter pylori Increases Gastric Antral Juxtamucosal pH**

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In order to examine the effect of Helicobacter pylori colonization on the gastric mucus microclimate, antral juxtamucosal pH was measured in 47 patients attending as outpatients for upper gastrointestinal endoscopy. The mean pH in 28 patients negative for H. pylori was 6.40 ± 0.24 compared to 6.88 ± 0.16 in 19 patients who were positive (P < 0.0001). In six of seven patients who agreed to a second study, H. pylori was eradicated and the mean pH fell from 6.81 ± 0.17 to 6.08 ± 0.16 (P < 0.001). The pH remained high in the one patient who remained positive (6.8 and 7.0). This study provides the first in vivo evidence that H. pylori can increase the antral juxtamucosal pH and suggests that ammonia production by the organism is capable of altering gastric mucus microclimate to impair the normal negative feedback controlling gastrin release. This observation may explain the coexistence of relative hypergastrinemia and H. pylori colonization in duodenal ulcer patients.

KEY WORDS: Helicobacter pylori; duodenal ulceration; gastric mucosal pH.

There is a strong association between Helicobacter pylori, chronic gastritis, and duodenal ulceration (1-3), but the exact pathogenetic mechanisms involved remain unresolved. Patients with duodenal ulceration are known to have a high gastric acid output and raised postprandial plasma gastrin levels, as well as an increased parietal cell mass (4). Nearly all patients with duodenal ulcer are colonized with H. pylori. As this organism produces a urease that hydrolyses urea to form ammonia, it has been suggested that it may cause changes in the microenvironment adjacent to the gastric mucosa. Ammonia may increase the antral juxtamucosal pH, thus allowing the organism to survive gastric acidity, and also impairing the normal negative feed- back of intraluminal acid on gastric secretion. This could lead to hypergastrinaemia and excess acid production (5). To test this hypothesis we have measured antral juxtamucosal pH directly in patients with and without H. pylori colonization and, in those in whom the organism was present, assessed the effects of its eradication.

**MATERIALS AND METHODS**

All measurements were carried out on patients attending for endoscopy as part of the investigation of dyspeptic symptoms. Approval for the study was obtained from the District Ethical Committee and patients gave informed consent. All patients who had taken any drugs during the preceding 48 hr, who had had gastric surgery, had visible bile in the antrum, or who tolerated endoscopy poorly were excluded from the study. All patients who had taken H2-receptor antagonists or proton pump inhibitors in the preceding two weeks were also excluded.

Initially a full endoscopic examination was carried out and the findings recorded. Antral juxtamucosal pH was then measured using a flexible glass pH microelectrode (Microelectrodes, Londonderry, New Hampshire, USA), which can be passed down the biopsy channel of standard endoscopes. The electrode was attached to a clinical pH
meter (PHM75, Radiometer, Copenhagen, Denmark) and chart recorder. Calibration was carried out at the beginning and end of each endoscopy session. The reference electrode was a standard silver-silver chloride electrode attached to the patient’s right shoulder.

Antral juxtamucosal pH was measured by advancing the tip of the electrode until it gently abutted against the mucosa where a juxtamucosal value was obtained as a steady pH reading (6). Measurements were taken from at least two antral sites. Biopsies were then taken from these sites for routine histology, including H. pylori status, and for a CLO test (Delta West Ltd., Australia) to detect urease production. For histology, biopsies were stained with haematoxylin and eosin and examined without knowledge of the juxtamucosal pH. Gastritis was graded as present or absent and chronic gastritis was indicated by inflammation with increased numbers of mononuclear lymphoid cells and active chronic gastritis by the presence of polymorphonuclear leukocytes in addition to increased mononuclear cells. The juxtamucosal pH value for each patient was determined at the time of endoscopy, before H. pylori status was known. Intraneous variability of antral juxtamucosal pH by this method was less than 5%. Repeat studies in individuals on separate occasions also demonstrated low variability of juxtamucosal pH at less than 6%.

Values were expressed as means with standard deviations and groups compared using group and paired t tests.

Those patients found to be positive for H. pylori were treated with colloidal bismuth subcitrate (DeNol, Gist Brocades) 240 mg twice daily for six weeks and metronidazole 400 mg three times daily for two weeks in an attempt to eradicate the organism. One month after completion of this treatment, these patients were invited to undergo a second endoscopy and pH measurement as before.

RESULTS

Measurements were made on a total of 47 patients, 28 were negative for H. pylori (14 male, average age 48.3 years) and 19 were positive (11 male, average age 46.2 years). The average antral juxtamucosal pH in the negative group was 6.40 ± 0.24 compared to 6.88 ± 0.16 in the positive group (P < 0.0001) (Figure 1).

In the H. pylori-negative group there were two duodenal ulcers and one gastric ulcer in patients taking NSAIDs and one further gastric ulcer. In the positive group there were four duodenal ulcers, two gastric ulcers, and one duodenitis. All H. pylori-positive patients had histological chronic gastritis with seven showing chronic active gastritis. Five H. pylori-negative patients also had histologically proven chronic gastritis. However, the presence of gastritis alone cannot explain the pH differences as five H. pylori-negative patients also had histologically proven chronic gastritis but a low mean pH of 6.46.

Seven patients agreed to a second study, and the organism was found to be successfully eradicated in six. In these the mean pH fell from 6.81 ± 0.17 initially to 6.08 ± 0.16 after eradication (P < 0.001). The pH remained high in the one patient who remained H. pylori-positive, being 6.8 initially and then 7.0 (Figure 2). Three of the six patients successfully eradicated initially had duodenal ulceration. All six showed an improvement in the original chronic active gastritis present before treatment.

DISCUSSION

This study demonstrates that infection with H. pylori increases the juxtamucosal pH in the gastric

![Fig 1. Effect of H. pylori colonization on antral juxtamucosal pH.](image)

![Fig 2. Effect of treatment to eradicate H. pylori on antral juxtamucosal pH.](image)