Gastrin Response to Protein Test Meal in Gastric Diseases

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INOUE, S. and NAKAGAWA, T. Gastrin Response to Protein Test Meal in Gastric Diseases. Tohoku J. exp. Med., 1980, 132 (1), 61-67 — The serum gastrin responses after ingestion of hard boiled eggs and Nutrient Broth solution were examined in peptic ulcer patients and normal subjects. The values observed of the serum gastrin response to these test meals were compared and contrasted. A significant enhancement of gastrin release in response to protein was obtained. There were no significant differences between the releases of gastrin after the two test meals. ————— gastrin release; protein meal

Protein, a mixture of amino acids, meat extract, and liver extract are known to cause release of gastrin (Kamionkowski et al. 1964; Korman et al. 1971; Wyllie et al. 1972; Walsh et al. 1975; Walsh and Grossman 1975). Walsh et al. (1975) reported that a mixture of amino acids produced a peak gastrin response that was approximately 60% of that produced by a meat meal. Therefore, liver extract, meat extract and various kinds of meals are often used for testing gastrin release. In this respect, Blair et al. (1975) reported that there were no significant differences in the peak gastrin response after meals varying in composition. In order to standardize the feeding test used to assess the gastrin response, protein feeding tests were employed.

The mechanisms of the gastrin-releasing action of peptide and amino acids of these test meals have not been fully elucidated. Several possibilities of release of gastrin by protein in the stomach are: 1) direct action on the G cell, 2) action through the nervous intermediation, 3) autoregulation of gastrin release by changing the intragastric pH, 4) stimulation by antral distention, and 5) a combination of these mechanisms. The role of antral alkalinization for gastrin release has been discussed, but it is admitted that alkalinization alone does not regularly increase serum gastrin. There is little evidence for an effect of alkali on serum gastrin. (McGuigan and Trudeau 1970; Feurle 1975)

In this study, the serum gastrin responses after ingestion of hard boiled eggs and 0.8% Nutrient Broth solution were performed in the same subjects on different days.

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MATERIALS AND METHODS

Five healthy persons, 10 patients with gastric ulcer and 10 patients with duodenal ulcer were investigated. Immunoreactive serum gastrin was measured by radioimmunoassay using Dianabott kit (Dianabott Co., Tokyo). Synthetic human gastrin I was used as standard.

After overnight fast, the subjects were given three hard boiled eggs (pH 7.3, consisting of 19 g of protein and 17 g of fat, egg test) or ingested 250 ml of 0.8% Bacto-Nutrient Broth solution (pH 6.8 at 25°C, Difco Lab., Detroit, USA, Nutrient Broth test), which consisted of Bacto-Beef Extract and Bacto-Peptone. Blood samples were drawn from the antecubital vein for gastrin measurement just before and at 15, 30, 45, 60 and 120 min after test meal ingestion. Sera were stored at -20°C until they were assayed. The conventional statistical methods were employed for the analysis of the data.

RESULTS

Fasting gastrin concentration

As shown in Table 1, fasting serum gastrin concentration was 73.3±7.6 pg/ml (mean±S.E.M.) in patients with gastric ulcer, 65.1±6.8 pg/ml in those with duodenal ulcer and 42.8±2.3 pg/ml in normal subjects before egg test. Fasting serum concentration was 75.1±6.5 pg/ml in patients with gastric ulcer, 69.3±5.9 pg/ml in those with duodenal ulcer and 46.2±6.7 pg/ml in normal subjects before Nutrient Broth test. Although the above figures of the ulcer groups are significantly different from those of the normal groups, if a large number of our other data on fasting gastrin concentration of normal groups are included, there were no statistically significant differences among the groups.

TABLE 1. The changes of serum gastrin concentration before and after ingestion of eggs and Nutrient Broth solution in normal controls, gastric ulcer and duodenal ulcer

<table>
<thead>
<tr>
<th>Meal</th>
<th>Subject</th>
<th>Number of subjects</th>
<th>Age (mean)</th>
<th>Time after test meal (min)</th>
<th>Change of serum gastrin concentration (pg/ml)</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Egg</td>
<td>Normal control</td>
<td>5</td>
<td>20.0</td>
<td>42.8</td>
<td>72.0*</td>
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<tr>
<td></td>
<td>Gastric ulcer</td>
<td>10</td>
<td>46.3</td>
<td>±2.3</td>
<td>±11.4</td>
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<tr>
<td></td>
<td>Duodenal ulcer</td>
<td>10</td>
<td>33.4</td>
<td>73.3</td>
<td>109.0*</td>
</tr>
<tr>
<td>Broth solution</td>
<td>Normal control</td>
<td>5</td>
<td>20.0</td>
<td>46.2</td>
<td>84.2*</td>
</tr>
<tr>
<td></td>
<td>Gastric ulcer</td>
<td>10</td>
<td>46.3</td>
<td>±6.7</td>
<td>±13.7</td>
</tr>
<tr>
<td></td>
<td>Duodenal ulcer</td>
<td>10</td>
<td>33.4</td>
<td>75.1</td>
<td>122.7*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±6.5</td>
<td>±19.2</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>69.3</td>
<td>132.3*</td>
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<td></td>
<td></td>
<td></td>
<td>±5.9</td>
<td>±33.3</td>
</tr>
</tbody>
</table>

Mean±S.E.M.  *p<0.05, †p<0.01.

Response to egg test meal

As illustrated in Figs. 1, 2 and 3 and Table 1, serum gastrin concentration in normal subjects increased from a mean fasting value of 42.8±2.3 pg/ml to a peak
Fig. 1. The changes of gastrin concentration before and after ingestion of eggs and Nutrient Broth solution in normal subjects. ●—●, egg; ○—○, broth. Mean ± S.E.M. (n=5).

Fig. 2. The changes of gastrin concentration before and after ingestion of eggs and Nutrient Broth solution in gastric ulcer. ●—●, egg; ○—○, broth. Mean ± S.E.M. (n=10.)
of 90.6 ± 14.5 pg/ml at 45 min after ingestion of eggs. Statistical testing showed a significant difference. In gastric ulcer, serum gastrin concentration increased from a mean fasting value of 73.3 ± 7.6 pg/ml to a peak of 120.7 ± 18.3 pg/ml at 45 min, after ingestion (p < 0.01). In duodenal ulcer, serum gastrin concentration increased from a mean fasting value of 65.1 ± 6.8 pg/ml to a peak of 136.9 ± 22.7 pg/ml at 30 min after ingestion (p < 0.01).

Concerning the peak value of gastrin after ingestion of egg, the peak in duodenal ulcer subjects was reached faster than in normal and gastric ulcer subjects.

Integrated gastrin secretions over 120 min period after ingestion were 523.6 pg/ml in normal subjects, 734.8 pg/ml in gastric ulcer and 795.4 pg/ml in duodenal ulcer.

Response to Nutrient test meal

In an attempt to correlate the result of gastrin release after ingestion of egg, the Nutrient Broth test was performed on the same subjects, who had already been examined through the egg test on different days.

Serum gastrin concentration in normal subjects increased from a mean fasting value of 46.2 ± 6.7 pg/ml to a peak of 82.4 ± 13.7 pg/ml at 15 min after ingestion (p < 0.05). In gastric ulcer, serum gastrin concentration increased from a mean fasting value of 75.1 ± 6.5 pg/ml to a peak of 133.0 ± 21.2 pg/ml at 30 min after
ingestion \((p<0.05)\). Serum gastrin concentration in duodenal ulcer increased from a mean fasting value of \(69.3\pm5.9\) pg/ml to a peak of \(132.3\pm23.3\) pg/ml at 15 min after ingestion \((p<0.05)\).

The peak value of gastrin after ingestion of Nutrient Broth solution was reached more rapidly than that of the egg test.

Integrated gastrin secretions over 120 min period after ingestion were 409.8 pg/ml in normal subjects, 775.9 pg/ml in gastric ulcer and 716.7 pg/ml in duodenal ulcer.

**Rate of increase in gastrin release**

The rate of increase in gastrin release based on the fasting value \( (=100\%)\) was 211% after ingestion of eggs and 182% after ingestion of Nutrient Broth solution in normal subjects. There were no significant differences between the rates of two test meals.

In gastric ulcer, the rate of increase in gastrin release was 165% after ingestion of eggs and 177% after ingestion of Nutrient Broth solution. There were no significant differences between the rates of two test meals. In duodenal ulcer, the rate of increase in gastrin release was 210% after ingestion of eggs and 191% after ingestion of Nutrient Broth solution. There were no significant differences between the rates of test meals.

As illustrated in Fig. 4, it can be seen that serum gastrin responses followed a similar pattern after ingestion of these test meals.

**Fig. 4.** Rate of increase in gastrin release after ingestion of eggs and Nutrient Broth solution in normal subjects, gastric ulcer and duodenal ulcer.
**DISCUSSION**

Many investigators have reported that there are no significant differences in the fasting serum gastrin level between gastric ulcer and duodenal ulcer (Korman et al. 1971b; McGuigan and Trudeau 1973; Walsh and Grossman 1973). In the present study, no statistically significant differences were found between peptic ulcer and normal subjects. Therefore, a stimulated releasing test of gastrin was employed using protein ingestion, which is the most potent releaser of gastrin (Walsh and Grossman 1975). But no clear-cut difference was observed in the gastrin release between the two test meals mentioned above. The need to standardize the releasing test of gastrin has been pointed out by Blair et al. (1975). Various kinds of foods such as liquid meal, steak and meat extract were employed in many reports, but the results were not satisfactory. The method of testing should be simple, reproducible and reliable. In this respect, the best test meal should be selected for the routine testing of gastrin response to protein.

There was a higher increase in serum gastrin in duodenal ulcer after protein meals in previous reports (Korman et al. 1971a; Stern and Walsh 1973).

Creutzfeldt et al. (1976) showed that the antral gastrin concentration of duodenal ulcer was significantly higher than that of control subjects, and that ultrastructurally G cells in the duodenal ulcer had many empty secretory granules suggesting higher functional activity. The present study has shown that serum gastrin response after protein meal in gastric and duodenal ulcer patients is greater than that in normal subjects. But it has failed to assess the discrepancy between gastric and duodenal ulcer.

Korman et al. (1971b) disclosed the peak gastrin response occurred 30 to 45 min after food intake. In this study, the peak gastrin response occurred 30 to 45 min after ingestion of eggs and 15 to 30 min after ingestion of Nutrient Broth solution.

The present study has proved a significant enhancement of gastrin release to protein and confirmed two test meals can be used to assess the antral function in gastric diseases.

**References**


