Hiroshima Journal of Medical Sciences
Vol. 33, No. 2, 125~130, June, 1984
HIJM 33-15

A Statistical Evaluation on the Age and Sex Distribution of Basal Serum Gastrin and Gastric Acid Secretion in Subjects with or without Peptic Ulcer Disease*)

Hamid TAHIR, Koji SUMII, Ken HARUMA, Akira TARI, Naomi UEMURA, Hideaki SHIMIZU, Masaaki SUMIOKA, Yoshiro INABA, Takashi KUMAMOTO, Yuji MATSUMOTO, Eiko SANUKI, Ken HIRATA, Kenji SUENAGA※, Toru HIDAKA※※, Goro KAJIYAMA and Akima MIYOSHI※※※

The First Internal Medicine, Hiroshima University School of Medicine, 1-2-3, Kasumi, Minami ku, Hirosima 734, Japan
※ *Futami Chuo Hospital, Miyoshi 728, Japan*
※※ *Asashimin Hospital, Hiroshima 731-02, Japan*
※※※ *Shizuoka Prefectural General Hospital, Shizuoka 420, Japan*

(Received January 9, 1984)

Key words: Age, Sex, Gastrin, Gastric acid, Peptic ulcer

ABSTRACT

The basal serum gastrin concentration and stimulated gastric acid secretion (MAO) were measured in 837 patients at Hiroshima University Hospital.

The basal serum gastrin concentration was significantly higher in males than females in the control group (normal and atrophic gastritis) and it was similar in patients with duodenal (DU) and gastric ulcer (GU), while MAO was significantly higher in males than females in all the groups.

The basal serum gastrin concentration increased and MAO decreased with age in the control group. In patients with DU and GU the basal serum gastrin concentration did not change but MAO decreased with age. In patients with DU below 20 years of age, both the basal serum gastrin concentration and MAO were higher than those of age above 20, and were higher than those of the control group less than 20 years old.

These findings may support the concept that in the control group increased gastrin release and decreased MAO with age result from achlorhydria or hypochlorhydria or from atrophy of the gastric mucosa; however, in patients with DU, especially in younger patients, gastrin plays a role in hypersecretion of gastric juice.

INTRODUCTION

It is well known that acid in gastric juice constitutes aggressive factors causing peptic ulcer, and gastrin is considered a principal humoral agent responsible for stimulation of gastric acid secretion[7,10,11,18,19]

An elevated serum gastrin concentration has been found in Zollinger-Ellison syndrome, pernicious anemia, renal insufficiency and several types of gastritis[5,11,14,19,20]. However, in peptic ulcer diseases the serum gastrin concentration is controversial. A low serum gastrin concentration was found by Korman et al.[7], while others found a normal or high serum gastrin concentration in patients with peptic ulcer[2,4,11,12,17].

Archimandritis et al.[1], and Ganguli et al.[5]

*) ハミド・タヒール，隅井浩治，春間 賢，田利 晶，上村直実，清水秀明，隅岡正昭，稲葉義郎，熊本 隆，松本勇次，讃岐英子，平田 研，末永健二，日高 徹，梶山梧朗，三好秋馬：健常者および消化性潰瘍における血清ガストリン，胃液分泌の年令性分布について

found no significant difference in the basal serum gastrin concentration in a healthy group of various ages, but Trudeau and McGuigan[18] found that a serum gastrin concentration increased with age. In contrast, MAO decreased significantly with age in a healthy group. Ganguli et al.[5] also found no significant difference in a basal serum gastrin concentration between males and females, whereas MAO in males was significantly higher than in females.

The aim of this study is to analyze statistically the basal serum gastrin concentration and MAO in a control group and patients with DU and GU matched in age and sex, and to discuss the pathogenetic role of gastric acid and gastrin in peptic ulcer.

MATERIALS AND METHODS

Samples were collected from 837 patients at Hiroshima University Hospital during the period from 1974 to 1982. These patients consisted of 205 patients with DU at the mean age of 41.17 ± 0.97 SE (13-79 years), 279 patients with GU at 50.25 ± 0.87 SE (16-83 years) and 353 patients without any gastroduodenal lesion as a control group at 41.68 ± 0.84 SE (15-78 years). The control group was confined to radiographically and endoscopically normal subjects with MAO above 7.25 mEq/hr[13], and also included those with atrophic gastritis, regardless of the acid output.

Gastric acid secretion test was performed by the method of the Committee for Evaluation of Gastric Acid Secretion Test organized by Japanese Society of Gastroenterology[15]. Determination of immunoreactive gastrin (IRGa) in the serum was performed using ^{125}I gastrin from Dainabot Co., antigastrin serum from Dr. Omata of Yokohama Municipal Citizens Hospital and synthetic human gastrin-17 (SHG-17) from ICI as a standard. Separation of free from bound gastrin was performed using Amberlite IRP 58 resin by modification of the Yallow and Berson's method[16,21].

Statistical analysis was made by Student's t test. The p level below 0.05 was defined as statistically significant.

RESULTS

The mean basal serum gastrin concentration and MAO in normal subjects and patients with DU and GU are shown in Table 1. The mean age of normal subjects was significantly lower than that of patients with DU ($p<0.01$) and GU ($p<0.001$). And it was significantly lower in patients with DU than GU ($p<0.001$). The basal serum gastrin concentration in patients with DU was similar to that in normal subjects and significantly lower than that in patients with GU ($p<0.01$). However, in patients with GU the basal serum gastrin concentration was significantly higher than that in normal subjects ($p<0.001$). MAO in patients with DU was significantly higher than that in normal subjects ($p<0.001$) and patients with GU ($p<0.001$). MAO in patients with GU was significantly lower than that in normals ($p<0.001$).

Fig. 1 shows the age distribution of the basal serum gastrin concentration in the control group, and patients with DU and GU. The basal serum gastrin concentration in the control group increased gradually with age. However, in patients with DU and GU the basal serum gastrin concentration was found almost evenly distributed in all age-matched groups.

Fig. 2 shows the age distribution of MAO

Table 1. Mean basal serum gastrin concentration and MAO in control, DU and GU

	n	Age	Serum Gastrin (pg/ml)	MAO (mEq/hr)
Normal	195	37.35±1.06	74.66±3.07	15.35±0.62
Duodenal Ulcer	205	41.17±0.97	76.93±3.26	20.45±0.62
Gastric Ulcer	279	50.25±0.87	92.27±3.42	11.05±0.05

※ $p<0.05$
※※ $p<0.01$
※※※ $p<0.001$

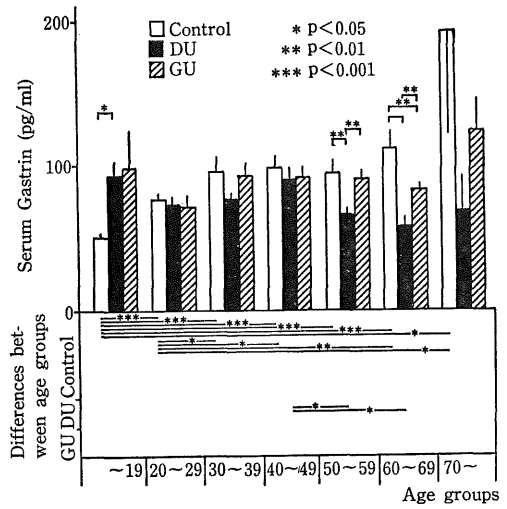

Fig. 1. Age distribution of basal serum gastrin concentration in control, DU and GU

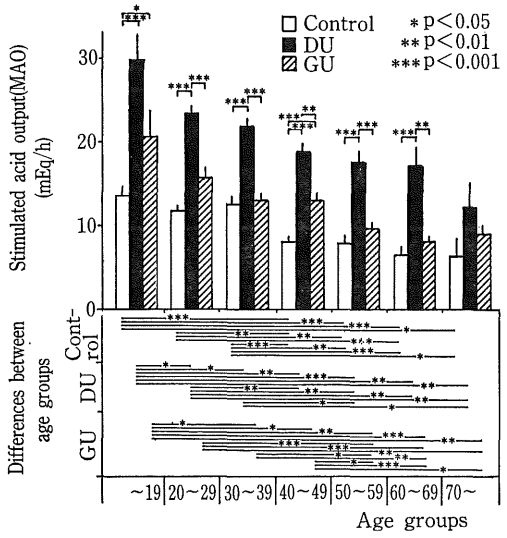

Fig. 2. Age distribution of MAO in control, DU and GU

in the control group (normal subjects and atrophic gastritis), and patients with DU and GU. In all the groups MAO decreased gradually with age. In age-matched groups, MAO in patients with DU was significantly higher than that in the control group and patients with GU except in those of age above 70.

The sex distribution of the basal serum gastrin concentration and MAO in the control group, and patients with DU and GU are listed in Table 2. This table shows higher incidences of DU and GU in males than in famales (3 : 1). In the control group the basal serum gastrin concentration was significantly higher in males than in females ($p<0.05$). However, in patients with DU and GU there was no significant difference between both sexes. In contrast, MAO was significantly higher in males than in females in the control group ($p<0.05$), and patients with DU ($p<0.001$) and GU ($p<0.05$).

The basal serum gastrin concentration and MAO in age and sex-matched control group and patients with DU and GU are demonstrated in Figs. 3 and 4. The basal serum gastrin concentration was slightly higher in males than in females of the control group. Conversely, in patients with DU and GU it was found to be slightly lower in males than in females (Fig. 3). MAO in the three groups did not show any difference between males and females in the same age-matched groups. In the three groups MAO in males was slightly higher than that in females; however, no statistically significant difference was noted (Fig. 4).

Fig. 5 shows the basal serum gastrin concentration and MAO in age below 20. Both the basal serum gastrin concentration and MAO

Table 2. Mean basal serum gastrin concentration and MAO in control, DU and GU of both sexes

	Sex	n	Age	Serum Gastrin (pg/ml)	MAO (mEq/hr)
Control	M	184	40.32±1.17	104.77±5.97 ※	10.79±0.64 ※
	F	169	43.15±1.20	86.53±5.08 ※	8.87±0.51 ※
Duodenal Ulcer	M	150	40.53±1.13	76.97±3.99	21.93±0.69 ※※※
	F	55	42.91±1.88	76.82±5.92	16.54±1.17 ※※※
Gastric Ulcer	M	210	49.65±0.99	91.73±3.99	12.03±0.55 ※※※
	F	69	52.07±1.83	93.93±6.67	8.08±0.61 ※※※

※ $p<0.05$
※※※ $p<0.001$

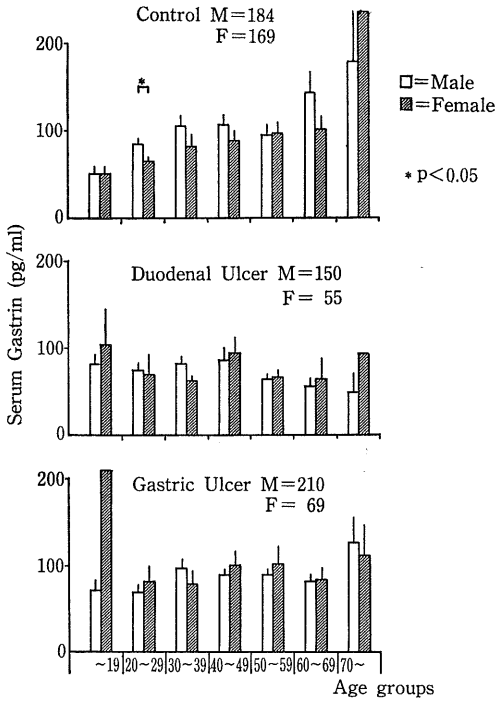

Fig. 3. Age and sex distrbution of basal semum gastrin concentration in control, DU and GU

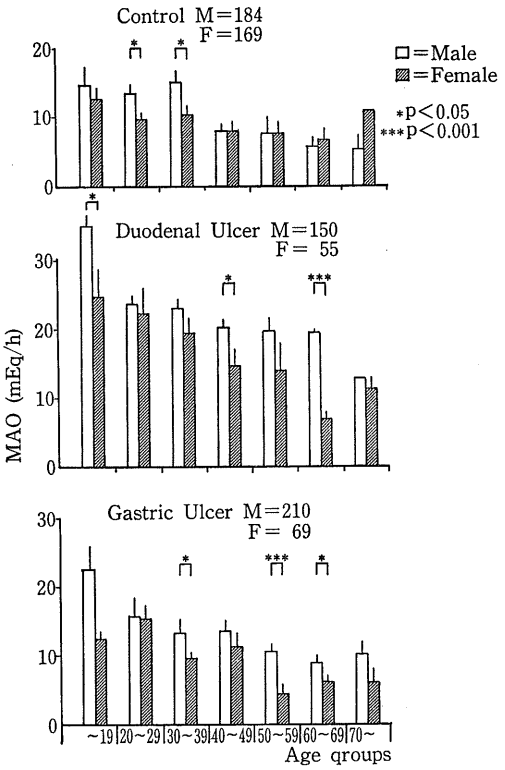

Fig. 4. Age and sex distribution of MAO in control, DU and GU

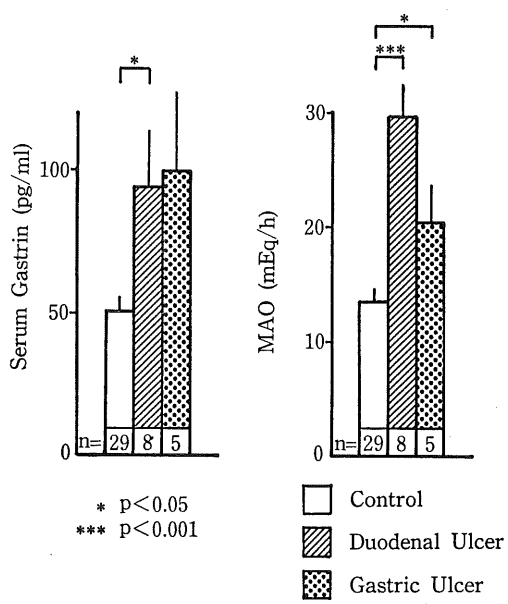

Fig. 5. Basal serum gastrin concentration and MAO in control, DU and GU at younger ages (less than 20).

in patients with DU were significantly higher than those in the control group ($p<0.05$ and $p<0.001$ respectively), and the basal serum gastrin concentration in patients with GU was slightly higher than that in the control group, whereas MAO was significantly higher than that in the control group ($p<0.001$).

DISCUSSION

In this study, the basal serum gastrin concentration in males was significantly higher than females in the control group and it was similar in patients with DU and GU.

Lam et al.[8] reported that the postprandial serum gastrin concentration has no sexual difference. MAO was significantly higher in males than females in the three groups. Kekki et al.[6] suggested that the lower acid output in females is due to the small area of gastric surface and a lesser number of parietal cells but not due to lower reactivity of the cells to stimulation.

In the control group, the basal serum gastrin concentration increased significantly with age, and the highest concentration was found in subjects over 70 years old. This finding may reflect the increasing frequency of atrophy of

the mucosa at old ages.

Archimandritis et al.[1], Trudeau and McGuigan[18] and Lambert[9] also found that the mean fasting serum gastrin concentration in a healthy group increased with age. They speculated that it was caused by achlorhydria or hypochlorhydria. Ganguli et al.[5] and Lambert[9] found a significantly higher serum gastrin concentration in subjects with achlorhydria or hypochlorhydria than in a normal group. We also found a significant decrease of MAO with age in the control group and patients with DU and GU. Decreasing MAO may have a relation to increasing atrophy of the gastric mucosa at older ages. Miyoshi et al.[13] have previously reported that the basal acid output (BAO), tetragastrin-stimulated acid output (MAO) and pepsin secretion decreased significantly with age in subjects with and without peptic ulcer disease

Cornet et al.[3] noted superficial gastritis and atrophic gastritis in 45% and 29% respectively of an old aged group with and without gastric symptoms.

Trudeau et al.[17] suggested that the direct relation between the serum gastrin concentration and age was the result of reduction in the rate of gastric acid secretion commonly observed at old ages. They also found an inverse correlation between the serum gastrin concentration and rate of gastric acid secretion, i. e., the lowest mean serum gastrin concentration was found among patients with a highest mean gastric acid secretion rate, and the highest mean serum gastrin concentration was found among patients with a lowest gastric acid secretion rate.

Most studies have shown that the fasting serum gastrin concentration of patients with DU does not differ from that of normal subjects. Previously, Sumii et al.[16] have shown that the fasting serum gastrin concentration in patients with DU was similar to or slightly higher than that in normal subjects not including those with atrophic gastritis, and after test meal which is a physiological stimulant for gastrin release, the serum gastrin concentration greatly increased in patients with DU, as compared with normal subjects. These findings indicated that the inhibitory feed-back mechanism of gastrin release which should follow acidification of the antrum and duodenum may be impaired in patients with DU. Sumii et al.[16] suggested that impairment of the feed-back mechanism resulted from the increased antral gastrin content and decreased antral somatostatin content in patients with DU.

In our present study, comparison of the basal serum gastrin concentration and MAO was made between the control group and patients with DU. Although MAO decreased significantly with age, the basal serum gastrin concentration did not increase in patients with DU and was higher than that in the control group of only young ages (less than 20). Thus at young ages both the basal serum gastrin concentration and MAO were higher in patients with DU than in the control group. It suggests that gastrin contributes to hypersecretion of gastric acid in young patients with DU.

Trudeau and McGuigan[17] reported that the serum gastrin concentration in patients with GU was significantly higher than that in normal subjects. In this study, we also found a significantly higher serum gastrin concentration in patients with GU than in normal subjects; however, when compared with the control group which consisted of normal subjects and patients with atrophic gastritis, no significant difference was noted. The basal serum gastrin concentration in the control group increased with age, while MAO decreased with age in both the control and patients with GU. In age-matched groups the basal serum gastrin concentration of the control group was similar to that of patients with GU. In young patients with GU, MAO was significantly higher than that in the control group and the basal serum gastrin concentration was slightly higher than that in the control group. In younger peptic ulcer patients (less than 20), aggressive factors in our present study increased not only in DU but also in GU. Furthermore, several investigators have been impressed by the frequency of a positive family history in many young patients with DU. Therefore, genetic factors seem to contribute to gastrin hypersecretion in those patients.

ACKNOWLEDGEMENT

The authors wish to thank Miss Takae Fujioka, secretary of the 4th Laboratory of the First Department of Internal Medicine, School of Medicine, Hiroshima University for her technical assistance for collection of data.

REFFERENCES

1. **Archimandritis, A., Alegakis, G. Theodoropaulo, S. G., Kalos, A.,Drivas, G.and Millisinos, K.** 1979. Serum gastrin concentrations in healthy males and females of various ages. Acta Hepato-Gastoent. **26** : 58-63.
2. **Berson, S. A. and Yalow, R. S.** 1971. Gastrin in duodenal ulcer. The New England J. of Med. **284** : 445-446.
3. **Cornet, A., Pagniez, G., Guerre, J. and et Delavierre, P.** 1964. La muqueuse gastrique des sujets âgés. Arch. Mal. Appar. Digest. **53** : 363-376.
4. **Byrnes, D. J., Young, Y. D., Chisolm, D. J. and Lazarus, L.** 1970. Serum gastrin in patients with peptic ulceration. Brit. Med. J. **II** : 626-629.
5. **Ganguli, P. C., Cullen, D. R. and Irvine, W. J.** 1971. Radioimmunoassay of plasma gastrin in pernicious anemia, achlorhydria without pernicious anemia, hypochlorhydria and in control. Lancet **1** : 155-158.
6. **Kekki, M., Samloff, I. M., Ihamaki, T., Varis, K. and Siurala, M.** 1982. Age and sex related behavior of gastric acid secretion at the population level. Scand. J. Gastroenterol. **17** : 737-743.
7. **Korman, M. G., Soveny, C. and Hansky, J.** 1971. Serum gastrin in duodenal ulcer. Part I. Basal levels and effect of food and atropin. Gut **12** : 899-902.
8. **Lam, S. K. and Ong, G. B.** 1980. Relationship of postprandial serum gastrin response to sex, body weight, blood group status, familial dyspepsia, duration and age of onset of ulcer symptoms in duodenal ulcer. Gut **21** : 528-532.
9. **Lambert, L.** 1972. Chronic gastritis. Digestion **7** : 83-126.
10. **McGuigan, J. E.** 1980. The role of gastrin in duodenal ulcer. Am. Clin. Climatol. Assoc. **92** : 199-207.
11. **McGuigan, J. E.** 1977. Serum gastrin in health and disease. Dig. Dis. **22** : 712-716.
12. **McGuigan, J. E. and Trudeau, W. L.** 1973. Differences in rates of gastrin release in normal person and patients with duodenal ulcer disease. The New England J. Med. **288** : 64-66.
13. **Miyoshi, A., Ohe, K., Inagawa, T., Inoue, M., Uraki, M., Tatsugami, S., Noguchi, A., Onda, M., Yokoya, H. and Shirakawa, T.** 1980. A statistical study on the age distribution of gastric secretion in patient with peptic ulcer. Hiro. J. Med. Sci. **29** : 21-28.
14. **Rayford, P. L. and Thompson, J. C.** 1977. Gastrin. Surgery, Gyn and Obst. **145** : 257-268.
15. **Report of Committee for Evaluation of Gastric Secretion Test;** on the method of determination of human gastric acid and pepsin secretion. Jap. J. Gastroenterol. (in Japanese) **71** : 207-209.
16. **Sumii, K., Yokoyama, Y., Matsui, Y., Kikkawa, N., Hidaka, T., Suenaga, K., Ohe, K. and Miyoshi, A.** 1979. The increased antral gastrin content and its release in response to test meal in patients with duodenal ulcer, Hiro. J. Med. Sci. **28** : 221-227.
17. **Trudeau, W. L. and McGuigan, J. E.** 1971 Relations between serum gastrin levels and rates of gastric hydrochloric acid secetion. The New England J. Med. **284** : 408-412.
18. **Trudeau, W. L. and McGuigan, J. E.** 1970. Serum gastrin levels in patients with peptic ulcer disease. Gastroenterol. **59** : 6-12.
19. **Walsh, J. H. and Grossman, M. I.** 1975. Gastrin; Second of two parts. The New England J. Med. **292** : 1377-1384.
20. **Walsh, J. H., Richardson, C. T. and Fordtran, J. S.** 1975. pH dependence of acid secretion and gastrin release in normal and ulcer subjects. The J. Clin. Invest. **55** : 462-468.
21. **Yalow, R. S. and Berson, S. A.** 1970. Radioimmunoassay of gastrin. Gastroenterol. **58** : 1-14.