Recent Trends in Colonic Diverticulosis in Yokohama City: A Possibility of Changing to a More Western Profile

Kazuo Tarao¹, Yusuke Sekino², Takashi Nonaka², Hiroshi Iida², Masahiko Inamori², Atsushi Nakajima³, Shin Maeda³, Yutaka Natsumeda¹, Tadashi Ikegami⁴ and Kenji Ohshige⁵

Abstract

Objective  Right-sided type colonic diverticulosis has been predominant in Japan, in contrast to European counties where the left-sided type is predominant. Considering the recent change in the dietary habits of Japanese people to a more Western diet in urban areas of Japan, the features of colonic diverticulosis may also change to reflect a more Western type. Therefore, we attempted to clarify the current situation.

Methods  A total of 435 consecutive outpatients who agreed to a barium enema and complete examination were enrolled in this study.

Results  113 patients (26.0%) revealed colon diverticulosis; 50.4% of the patients had more than ten diverticula. The percentage of men with ten or more diverticula (67.4%) was significantly higher than that of women patients (40.0%, p<0.01). Among the 88 patients who had four or more diverticula, 39 patients (44.3%) were right-side dominant, 27 (30.7%) left-side dominant and 22 (25.0%) were both-sides. Thirteen (68.4%) of the 19 patients who had more than 30 diverticula were left-side dominant.

Conclusion  The clinical features of colon diverticulosis in the patients living in Yokohama may be changing to reflect a more Western type, in particular decreased right-side dominance, increases in the left-side and both-sides dominant patients, and the emergence of patients with crowded diverticula in the left-side colon was observed.

Key words: colon diverticulosis, right-sided colon, left-sided colon, barium enema, double-contrast barium enema

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Introduction

It is well known that right-sided colonic diverticulosis is the predominant form of colonic diverticulosis in Japan (1-7), in contrast to European countries where the left-sided type is dominant (8-12). Moreover the total numbers of diverticula in Japanese patients was considered to be less than ten in the majority of patients, in contrast to European patients who typically have more than ten (3, 5).

However, in recent years the dietary habits of Japanese people have changed from Japanese to a more Western diet in those who live in urban areas, especially in the larger cities; people consume more meats and fewer vegetables, including cereal fibers of rice.

Thus, it may be that the location of the colonic diverticula may change from predominately right-sided to left-sided in Japanese people living in large cities to reflect their Western dietary habits. Indeed, the proportion of right-sided diverticula is reported to be gradually decreasing over time (1-5).

However, the most recent study, concerning the proportion of right-sided diverticula was conducted in 2005.

The precise locations and actual number of colonic diverticula are more accurately recognized using barium enemas rather than colonoscopy (4, 13-16). In a retrospective analysis, barium enemas were shown to have a sensitivity of 62-
side) occupied more than two-thirds of the total number, we colon included the descending colon and sigmoid colon. Specifically, the right side of the colon included the caecum, ascending colon, transverse colon, and the left side of the colon was made by the definition from previous papers (4, 6); each patients. The classification of the right side and left side of the colon was made by the definition from previous papers (4, 6); specifically, the right side of the colon included the caecum, ascending colon, transverse colon, and the left side of the colon included the descending colon and sigmoid colon. If the number of diverticula on one side (right or left side) occupied more than two-thirds of the total number, we recognized that side as being dominant. If there was no dominant side, we considered the patients to be “both-sided.”

**Study population**

A total of 435 consecutive outpatients who agreed to a double-contrast barium enema examination and complete examination performed at Tarao’s Gastroenterological Clinic and in Yokohama City University Hospital between 25 June 2005 and 21 June 2014 were enrolled in this study. Most of these patients preferred a barium enema examination, rather than a colonoscopic examination, for the survey of colonic diverticulosis, and calculated the number of diverticula in the patients overall. In 25 cases (22.1%), there were at least to 20 diverticula. The average number of diverticula for all patients was 17.6±2.4.

| Number of diverticula | Number of cases | %   |
|-----------------------|-----------------|-----|
| ≤ 5                   | 25              | 22.1|
| 4-9                   | 31              | 27.4|
| 10-19                 | 32              | 28.3|
| ≥ 20                  | 25              | 22.1|

94%, and false negative results in only 2-15% of the cases (17).

In contrast, Murano et al. (6) found that the sensitivity of the colonoscopy examination for the diagnosis of colon diverticulosis was 47.1% of the cases found by barium enemas. However, in recent years, the use of a colonofiberscope has become so prevalent in the study of the colon that double-contrast barium examinations are not frequently performed.

Considering the aforementioned facts, we examine the numbers and distributions or locations of colonic diverticula using double-contrast barium enemas, in patients living in Yokohama City.

**Materials and Methods**

**Statistical analyses**

Pearson’s $\chi^2$ test, the Student’s t-test and the Mann-Whitney U test were used for statistical analyses. Statistical significance was considered to exist at $p<0.05$.

**Results**

One hundred and thirteen patients (26.0%) revealed colon diverticula. Their age ranged from 39 to 86 years (average 67.0±11.2 years, mean ± S.D.). The average age of the men was 67.8±11.2 years and that of the women was 66.5±11.2 years. There were no significant differences in the average age between the gender. Forty three patients (38.1%) were men and 70 patients (61.9%) were women. The majority of the patients had been living in Yokohama for more than 30 years.

The classification of the right side and left side of the colon was made by the definition from previous papers (4, 6); specifically, the right side of the colon included the caecum, ascending colon, transverse colon, and the left side of the colon included the descending colon and sigmoid colon.

If the number of diverticula on one side (right or left side) occupied more than two-thirds of the total number, we

**Table 1. Distribution of the Numbers of Diverticula in All Patients.**

| Number of diverticula | Number of cases | %   |
|-----------------------|-----------------|-----|
| ≤ 5                   | 25              | 22.1|
| 4-9                   | 31              | 27.4|
| 10-19                 | 32              | 28.3|
| ≥ 20                  | 25              | 22.1|

**Table 2. The Percentage of Patients by Age Category.**

| Number of diverticula | <40 | 40-49 | 50-59 | 60-69 | ≥70 |
|-----------------------|-----|-------|-------|-------|-----|
| 1-9                   | 3   | 5     | 10    | 17    | 21  |
| 10-19                 | 0   | 1     | 1     | 10    | 20  |
| 20-29                 | 0   | 0     | 1     | 3     | 2   |
| 30-39                 | 0   | 0     | 1     | 1     | 4   |
| 40-49                 | 0   | 0     | 1     | 2     | 0   |
| 50-59                 | 0   | 0     | 1     | 0     | 0   |
| 60-69                 | 0   | 0     | 0     | 1     | 3   |
| 70-79                 | 0   | 0     | 0     | 0     | 1   |
| 80-89                 | 0   | 0     | 0     | 2     |     |
| 90-99                 | 0   | 0     | 0     | 0     |     |
| 100-109               | 0   | 0     | 0     | 0     |     |
| 110-119               | 0   | 0     | 0     | 0     |     |
| 120-129               | 0   | 0     | 0     | 0     |     |
| 130-139               | 0   | 0     | 0     | 0     |     |
| 140-149               | 0   | 0     | 0     | 0     |     |
| 150-159               | 0   | 0     | 0     | 1     | 0   |
| Total                 | 3   | 6     | 15    | 35    | 54  |
| (%)                   | (2.7)| (5.3)| (13.3)| (31.0)| (47.8)|
and hard stools were higher in the patients with diverticula while, the incidence of physical exercise was significantly higher in the patients without diverticula than in those without (p<0.001 and, p<0.005, respectively). The past history of melena was 2.0% (2/101) (Fig. 1). The average number of diverticula in the men (24.3±32.7, mean 13.0) was significantly higher than in the women (13.5±18.6, mean: 7.0; p=0.008, Mann-Whitney U test).

Table 4 shows the dominant side (right-sided, left-sided, or both-sided) of the diverticula in the 88 patients who had four or more diverticula. Thirty-nine (44.3%) of the 88 patients were right-side dominant, 27 (30.7%) were left-side dominant and 22 (25.0%) were both-sided. Although the number of right-side dominant cases was the highest, they represented less than half of the 88 patients. Left-side dominant and both-side cases occupied 55.7% of the cases. The tendency was approximately the same among men (right-side dominant, 40.5%) and women (right-side dominant, 47.1%) (Table 5, 6).

In the right-side dominant cases, the majority of the cases had many diverticula in the ascending colon with few to several diverticula in the caecum or transverse colon. In the left-side dominant cases, the majority of cases had many diverticula in the sigmoid colon with few to several diverticula in the descending colon.

The characteristic features in the men and women with regard to the number of colon diverticula are shown in Fig. 2. Among the men, 29 of 43 (67.4%) patients had more than 10 diverticula. In contrast, among the women, 42 of 70 (60.0%) patients had less than 10 diverticula and only 28 (40.0%) of the patients had more than 10 diverticula (p<0.01).

The twenty-five cases with more than twenty colon diverticula are shown in Table 7. Fourteen patients (56.0%) out of 25 belonged to the left-side dominant group. Only five (20.0%) patients belonged to the right-side dominant group.

Table 8 shows the nineteen cases with more than thirty colon diverticula. Thirteen (68.4%) patients out of 19 belonged to the left-side dominant cases, while none of the patients were right-side dominant.
Table 4. Dominant Side (Right-side, Left-side or Both-side) of the Diverticula in the Total of 88 Patients who Had 4 or More Diverticula.

| Dominant side | Number of cases | %   |
|---------------|-----------------|-----|
| Right-side (R)| 39              | 44.3|
| Left-side (L) | 27              | 30.7|
| Both-side (B) | 22              | 25.0|

Table 5. Dominant Side (Right-side, Left-side or Both-side) of the Diverticula in the 37 Male Patients who Had 4 or More Diverticula.

| Dominant side | Number of cases | %   |
|---------------|-----------------|-----|
| Right-side (R)| 15              | 40.5|
| Left-side (L) | 10              | 27.0|
| Both-side (B) | 12              | 32.4|

Table 6. Dominant Side (Right-side, Left-side or Both-side) of the Diverticula in the 51 Female Patients who Had 4 or More Diverticula.

| Dominant side | Number of cases | %   |
|---------------|-----------------|-----|
| Right-side (R)| 24              | 47.1|
| Left-side (L) | 17              | 33.3|
| Both-side (B) | 10              | 19.6|

Discussion

In the past, the differences in the features of colon diverticulosis between Western countries and Japan were considered to be the dominant location in the colon and the total number of diverticula. Namely, in the patients from Western countries the left side was the dominant side (8-12), including the sigmoid colon (20-23), while in Japanese patients the right side was demonstrated to be the dominant side (1-7).

Concerning the total number of colon diverticula, in Western counties more than 10 diverticula are typically found in the patients with colon diverticulosis (21); in contrast, less than 10 diverticula are typically present in many Japanese patients (1).

Our data revealed less than half of the patients (44.3%) were right-side dominant. Left-side dominant and both-side occupied the 55.7% of the cases. Concerning the dominant side of colon diverticulosis in Japan, Ishikawa et al. (18) investigated the time course of the percentages of right-sided colon diverticula and found that it decreased gradually over time.

Munakata et al. (7) examined the proportion of right-side dominant colonic diverticulosis in five hospitals located in large cities across Japan, and found that the ratio of right-side dominant colonic diverticulosis was approximately 70-80% in each hospital and the ratio did not fluctuate significantly during the period between 1975 and 1986. Inoue et al. (1) also reported approximately the same ratio (75.1%) for right-side dominant colonic diverticulosis in 1980.

Subsequently, in 1992, Inoue et al. (3) demonstrated that the ratio of right-sided diverticula had decreased to 69.3%. In 2005, Matsuda et al. (4) and Imaeda et al. (5) reported further decreases in the ratio of right-sided colon diverticula; (52.0% and 51.9%, respectively). Considering the tendency of the ratio of right-sided colon diverticulosis to decrease over time, our result of 44.3% right-side dominant cases appears to be logical because our study data were collected during 2005-2014.

With regard to the number of diverticula in Japan, Inoue et al. (3) mentioned that the percentages of patients who have more than 10 diverticula was only 13% in 1992. Subsequently, Imaeda et al. (5) stated that the percentage of patients who had more than 10 diverticula had risen to 33.6% in 2005. Continuing this trend, our data demonstrated that the percentage of patients with more than 10 diverticula was as high as 50.4% (57 of 113). The reason for this marked difference may be partly due to the higher age of the patients in our study (67.0±11.2 years old), however the possibility of an effect of a more Westernized diet, including low dietary fiber (especially crude cereal fiber from rice) may exist, as seen in Western countries (11, 12, 19).

Our study also demonstrated that the percentage of men who had more than 10 diverticula was as high as 67.4% and was significantly higher than the women (40.0%). Consistent with our results, Inoue et al. (1) demonstrated that the percentage of patients with multiple diverticula was smaller for the women compared with the men.

Additionally, our study demonstrated that 25 of 113 patients (22.1%) had more than 20 diverticula, and of the 25 cases 14 (56.0%) were left-side dominant cases. The tendency for a predominance of left-sided diverticula was stronger in the patients who had more than 30 diverticula (left-side dominant 68.4%, right-side dominant 0%, both-side dominant 31.6%). Inoue et al. also speculated that with
advancing age, multiple diverticula may develop and the majority of them would be left-sided (1, 3).

The typical clinical features of colon diverticulosis in Western countries are considered to be left-sided colon diverticulosis including the sigmoid colon crowded with many diverticula (10), and approximately 90% of the patients with colon diverticulosis are left-side dominant (20). Our present study in Yokohama City demonstrated the existence of left-sided colon crowded with more than 20-30 or more diverticula. This phenomenon appears to be characteristic evidence of a Westernized pattern of diverticula in a large Japanese city, such as Yokohama.

An important factor associated with the development of colon diverticulosis in Western countries may be a deficiency of dietary fiber intake (21-23). Indeed, Brodribb (24) examined the intake of crude fiber in the patients with colon diverticula compared with control patients and found that the intake of crude fiber intake in the former (2.6 g/day) was significantly lower than in the latter (5.2 g/day). The main reason why the features of colon diverticulosis in Yokohama City in our study had changed toward a Western-style is probably due to a reduced dietary fiber intake. Mu-

Table 7.  Twenty-five Cases with More than 20 Colon Diverticula.

| Age | Sex | No. of diverticula | Location (side of the majority of diverticula) |
|-----|-----|--------------------|------------------------------------------|
| 75  | M   | 65                 | L                                        |
| 82  | M   | 75                 | L                                        |
| 80  | M   | 30                 | B                                        |
| 81  | F   | 82                 | L                                        |
| 61  | F   | 43                 | L                                        |
| 65  | F   | 39                 | L                                        |
| 67  | M   | 47                 | L                                        |
| 71  | M   | 22                 | R                                        |
| 72  | F   | 82                 | L                                        |
| 57  | F   | 42                 | B                                        |
| 71  | F   | 20                 | R                                        |
| 75  | F   | 65                 | L                                        |
| 66  | F   | 21                 | R                                        |
| 70  | M   | 35                 | B                                        |
| 54  | M   | 28                 | R                                        |
| 68  | M   | 23                 | L                                        |
| 86  | M   | 32                 | L                                        |
| 50  | M   | 53                 | B                                        |
| 65  | F   | 68                 | L                                        |
| 69  | M   | 157                | L                                        |
| 79  | M   | 36                 | B                                        |
| 68  | M   | 27                 | R                                        |
| 77  | F   | 64                 | L                                        |
| 76  | M   | 141                | B                                        |
| 57  | M   | 31                 | L                                        |

L: left-side dominant, R: right-side dominant, B: both-side dominant
L : R : B = 14 : 5 : 6

Table 8. Nineteen Cases with More than 30 Colon Diverticula.

| Age | Sex | No. of diverticula | Location (side of the majority of diverticula) |
|-----|-----|--------------------|------------------------------------------|
| 75  | M   | 65                 | L                                        |
| 82  | M   | 75                 | L                                        |
| 80  | M   | 30                 | B                                        |
| 81  | F   | 82                 | L                                        |
| 61  | F   | 43                 | L                                        |
| 65  | F   | 39                 | L                                        |
| 67  | M   | 47                 | L                                        |
| 72  | F   | 82                 | L                                        |
| 57  | F   | 42                 | B                                        |
| 75  | F   | 65                 | L                                        |
| 70  | M   | 35                 | B                                        |
| 86  | M   | 32                 | L                                        |
| 50  | M   | 53                 | B                                        |
| 65  | F   | 68                 | L                                        |
| 69  | M   | 157                | L                                        |
| 79  | M   | 36                 | B                                        |
| 77  | F   | 64                 | L                                        |
| 76  | M   | 141                | B                                        |
| 57  | M   | 31                 | L                                        |

L: left-side dominant, R: right-side dominant, B: both-side dominant
L : R : B = 14 : 0 : 5
nakata et al. (7, 25) demonstrated an inverse correlation between the prevalence of colon diverticulosis and the dietary fiber intake in their study conducted in five large cities in Japan. Munakata et al. and Oh! et al. (26) pointed out that the intake of dietary fiber in Japan has been gradually decreasing because the consumption of rice, which was a principal source of dietary fiber for a long time, has been decreasing, especially in urban areas (25).

The Japanese Ministry of Health, Welfare and Labour has reported a decreasing proportion of rice consumption in the total caloric intake over time: 55.8% in 1965, 39.2% in 1975, 34.2% in 1991 (27) and 29.5% in 2012 (28).

In conclusion, our study demonstrated that the clinical features of colon diverticulosis in patients living in Yokohama City are changing to a more Western type; the ratio of right-side dominant patients has decreased to less than half of all patients, left-side dominant and both-side cases occupied more than half of all patients, and the patients had crowded diverticula in the left-sided colon. Additionally, an increased ratio (50.4%) of patients having more than 10 diverticula was further evidence for the Western type of colon diverticulosis.

The authors state that they have no Conflict of Interest (COI).

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