The Clinical Factors for Predicting Severe Diverticulitis in Korea: A Comparison with Western Countries

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Background/Aims: It is unclear whether the risk factors associated with complicated diverticulitis in Asian and Western countries are the same. We evaluated the risk factors associated with severe diverticulitis (SD) in Korea and compared the clinical characteristics of diverticulitis according to location. Methods: A retrospective review of 190 patients hospitalized with acute diverticulitis from January 2005 to June 2010 was conducted. SD was defined as one of the following: perforation, abscess, obstruction, sepsis, or peritonitis that required an urgent operation. Results: Twenty-four patients (12.6%) were diagnosed with SD. SD was significantly associated with older age, a fever over 38°C, changes in bowel habits and a high visceral adipose tissue (VAT)/total adipose tissue (TAT) ratio. Multivariate analysis showed that the risk factors for developing SD were an age of 40 years or more (odds ratio [OR], 3.2; p=0.032), male gender (OR, 4.0; p=0.021) and left-sided diverticulitis (OR, 6.2; p=0.017). Right-sided diverticulitis (n=175, 92.1%) was significantly associated with younger ages, fewer changes in bowel habits, fewer comorbidities and non-SD. Conclusions: This study suggests that the risk factors for developing SD in Korea, where right-sided diverticulitis is predominant, are the male gender, an age of more than 40 years old, and left-sided diverticulitis. Given that there are different risk factors for developing SD in Western countries, different strategies for the treatment of diverticulitis in the Korean population seem to be needed. (Gut Liver 2012;6:78-85)

Key Words: Diverticulitis; Diverticulosis; Location; Obesity

INTRODUCTION

Diverticula can occur at any sites in the colon. However, there are great variations in the incidence and distribution of diverticula in different geographic areas. In the Western population, in approximately 95% of cases, diverticula involve the sigmoid and left colon. With increasing age, they occur progressively more proximally. Consequently, right-sided diverticular disease is observed in older patients with pan-diverticulosis.1 The incidence of left-sided diverticulitis is estimated above 96%.2 In contrast, diverticular disease in Asian societies occurs primarily on the right side of the colon, with as many as 70% of the diverticula isolated to the right side. Right-sided diverticula occur at a younger age, with left-sided diverticula occurring later. The incidence of right-sided diverticulitis is estimated 75%.3 This discrepancy in the pattern of disease according to geographic variation may help us clarify its etiology. In that point, location of diverticula is of particular interest.

Diverticulitis is a disease with wide spectrum of severity that runs from isolated, mild, acute attacks to severe, recurrent disease. Of those patients with diverticulitis, 15% to 20% will develop significant complications, such as abscess, fistula, obstruction, phlegmon, bleeding or perforation, and the overall mortality of those requiring surgery for perforated diverticular disease was reported between 12% and 36%.4 Therefore, identification of predicting factors for complicated diverticulitis has received wide attention. In Western populations, younger age, female, obesity, smoking, recurrence, and comorbidity have been reported as risk factors of severe diverticulitis (SD), despite controversies. Historically, the treatment guideline has been based on some of these risk factors.5,6 While there has been extensive study of the risk factors of SD in Western popula-
tion, relatively limited investigation of those in Asian populations (who have different characteristics of diverticulosis) has been reported. Although left-sided location of diverticulitis has been consistently reported as a significant risk factor of SD in Asia,\(^7\)\(^{12}\) there was few study performing extensive investigation handling variable risk factors of SD. Furthermore, risk factors predicting the complication of diverticulitis in Far East Asian countries differ from those in Western countries, with regard to age and recurrence.\(^8\)\(^{13}\) Therefore, it seems inappropriate to follow the Western treatment guideline when treating the Asian population. This study was designed to evaluate the risk factors of SD in Korea, and additionally to compare the clinical characteristics of diverticulitis according to the location, which seemed to be the main difference between Western and Asian populations.

**MATERIALS AND METHODS**

**1. Patients**

A retrospective review of 190 patients hospitalized with acute diverticulitis from January 2005 to June 2010 was conducted. All data, such as patient’s demographics, obesity parameters including body mass index (BMI), and waist circumference (WC), comorbid disease, symptoms, physical examination findings, white blood cell counts, investigations performed and pathologic reports, type of treatment, complications, duration of admission, and recurrence were collected through the computer review of medical records of the patients. Patients characteristics are defined as follows: For smoking, only current smoker were included. Comorbidity was defined as cardiopulmonary, endocrinologic, neurologic, malignant, and connective tissue diseases that were accompanied with known diverticulitis. Chronic constipation was defined as bowel movement with strain occurring less than 3 times a week. Bowel habit change was defined as new onset diarrhea or constipation. Recurrent diverticulitis was defined as acute diverticulitis occurred more than once. All patients underwent either the computed tomography (n=187) or the abdominal sonography (n=3) under the clinical suspicion of colonic diverticulitis. This study protocol was approved by the local ethics committee in our institute.

**2. Definition of acute severe diverticulitis**

The diagnosis of acute diverticulitis was defined as clinically suspected diverticulitis at presentation, in which 1) diverticulitis was definitely shown on the computed tomography (n=48), or 2) diverticulum was observed in the barium enema (n=118) or colonoscopy (n=17) after the treatment of suspected diverticulitis, or 3) diverticulitis was pathologically confirmed after the operation (n=11). Patients with appendicitis after the pathologic confirmation were excluded, even though they fell under the 1) or 2). SD was defined as at least one of the followings: perforation (either localized or free perforation), abscess, fistula, obstruction, sepsis, and peritonitis requiring urgent operation.

**3. Measurement of obesity by computed tomography (CT) scan**

The patients were scanned with either 4-detector CT scanner (Somatom Volume Zoom; Siemens Medical Solutions, Forchheim, Germany) or 64-detector CT scanner (Aquilion; Toshiba, Tochigi, Japan). A single 5 mm thick slice through the umbilicus level was obtained by 120 kVp and automatic tube current dose modulation system during 0.5 seconds scan time. Abdominal

| Table 1. Patient Characteristics                                                                 | No. of patients (n=190) |
|-------------------------------------------------------------------------------------------------|-------------------------|
| Age, yr                                                                                           | 39.9±13.4               |
| Male                                                                                              | 101 (53.2)              |
| Obesity                                                                                            |                         |
| BMI, kg/m\(^2\)                                                                                   | 23.2±3.4                |
| CT measurement, cm\(^2\)*                                                                         |                         |
| VAT                                                                                               | 108.7±55.9              |
| SAT                                                                                               | 151.7±63.2              |
| TAT                                                                                               | 260.4±97.0              |
| Waist circumference, cm\(^*\)                                                                     | 81.5±8.8                |
| Smoking                                                                                            | 78 (41.4)               |
| Location                                                                                            |                         |
| Right-sided diverticulitis                                                                       | 175 (92.1)              |
| Left-sided diverticulitis                                                                         | 15 (7.9)                |
| Range of divertica                                                                                |                         |
| Right                                                                                             | 146 (76.9)              |
| Left                                                                                              | 9 (4.7)                 |
| Both (right and left)                                                                             | 35 (18.4)               |
| No. of diverticula                                                                                 |                         |
| Single                                                                                             | 64 (33.7)               |
| Multiple                                                                                            | 126 (66.3)              |
| Comorbidity                                                                                        | 32 (16.8)               |
| Recurrence                                                                                        | 9 (4.7)                 |
| Complication                                                                                      | 24 (12.6)               |
| Perforation                                                                                        | 16 (66.7)\(^*\)         |
| Abscess                                                                                            | 10 (41.7)\(^*\)         |
| Fistula                                                                                            | 2 (8.3)\(^*\)           |
| Obstruction                                                                                        | 0 (0.0)\(^*\)           |
| Sepsis                                                                                             | 1 (4.2)\(^*\)           |
| Peritonitis requiring emergent operation                                                          | 1 (4.2)\(^*\)           |
| Operation                                                                                         | 11 (5.8)\(^*\)          |

Data are presented as mean±SD or number (%). BMI, body mass index; CT, computed tomography; VAT, visceral adipose tissue; SAT, subcutaneous adipose tissue; TAT, total abdominal adipose tissue.

\(^*\) Available number of patients, 172; \(^\dagger\) Number of cases with complications \{number of cases/number of patients with complications\}×100, overlapping cases were available.
adipose tissue was calculated at this slice using the off-line workstation (Aquarius software, version 3.6.3.0; TeraRecon Inc., Foster City, CA, USA). It determined the adipose tissue area electronically by setting the attenuation values for the region of interest within a range of -190 and -30 Hounsfield units. Visceral adipose tissue (VAT), subcutaneous adipose tissue (SAT), and total abdominal adipose tissue (TAT) were determined separately with the use of a trace function, which manually defined the boundary between the visceral and subcutaneous fat with a cursor.

4. Statistical analysis

Analysis was performed using the SAS for Windows software version 9.1 (SAS Institute Inc., Cary, NC, USA). For univariate analysis for identification of patients characteristics according to the severity, statistical significance was taken as p-values <0.05 by chi-square for the categorical variables and a t-test for the continuous ones. In addition, patients characteristics which were previously investigated as potential risk factors of SD in the literature were selected from the variables belonged to univariate analysis to identify risk factors of SD by multivariate analysis. Some variables considered as signs of SD, rather than risk factors, such as fever and bowel habit change were excluded for the multivariate analysis, even though they were significant factors in the univariate analysis. For multivariate analysis, binary logistic regression method was used.

RESULTS

1. Characteristics of study population

There were a total of 190 patients (101 males, 89 females). The mean±standard deviation age of population was 39.9±13.4 years. The parameters related to obesity were within normal range, as follows: mean BMI (23.2±3.4 kg/m²), mean VAT (108.7±55.9 cm²), mean TAT (260.4±97.0 cm²) and mean WC (81.5±8.8 cm). Isolated right-sided diverticula (76.9%) were observed most frequently, and subsequently right-sided diverticulitis (92.1%) occurred most frequently. However, even in patients with diverticula on both sides of the colon (n=35, 18.4%), right-sided diverticulitis (n=29, 82.9%) was more common. Nine

Table 2. Patients Characteristics according to the Severity

| Characteristic                        | No. of patients with SD (n=24, 12.6%) | No. of patients with NSD (n=166, 87.4%) | p-value |
|--------------------------------------|---------------------------------------|----------------------------------------|---------|
| Age, yr                              | 49.1±14.9                             | 38.5±12.7                              | <0.001  |
| Male                                 | 17 (70.8)                             | 84 (50.6)                              | NS      |
| Obesity                              |                                       |                                        |         |
| BMI, kg/m²                           | 23.3±3.5                              | 23.1±3.4                               | NS      |
| Waist circumference, cm              | 82.8±9.9                              | 81.3±8.6                               | NS      |
| CT measurement*                      |                                       |                                        |         |
| VAT, cm²                             | 138.0±76.7                            | 104.5±51.1                             | NS      |
| SAT, cm²                             | 130.1±45.2                            | 154.8±65.0                             | NS      |
| TAT, cm²                             | 268.1±112.5                           | 259.3±94.8                             | NS      |
| VAT/TAT, %                           | 48.8±12.6                             | 40.0±12.6                              | 0.002   |
| Smoking                              | 9 (37.5)                              | 69 (41.6)                              | NS      |
| Fever (>38.3°C)                      | 7 (29.2)                              | 17 (10.2)                              | 0.017   |
| Leukocytosis (WBC >10,000/mm³)       | 21 (87.5)                             | 121 (72.9)                             | NS      |
| Location of diverticulitis (Rt./Lt.) | 18/6 (75.0/25.0)                      | 157/9 (94.6/5.4)                       | 0.005   |
| Range of diverticula (pan-colon)     | 2 (8.3)                               | 33 (19.9)                              | NS      |
| No. of diverticula (single/multiple) | 8/16 (33.3/66.7)                      | 56/110 (33.7/66.3)                     | NS      |
| Comorbidity                          | 7 (29.2)                              | 25 (15.1)                              | NS      |
| Chronic constipation                 | 1 (4.2)                               | 6 (3.6)                                | NS      |
| Bowel habit change                   | 7 (29.2)                              | 19 (11.4)                              | 0.027   |
| Nausea/Vomiting                      | 4 (16.7)                              | 18 (10.8)                              | NS      |
| Tenderness/Rebound tenderness        | 23/15 (95.8/62.5)                     | 166/104 (100.0/62.7)                   | NS/NS   |
| Recurrence                           | 2 (8.3)                               | 7 (4.2)                                | NS      |

Data are presented as mean±SD or number (%).
SD, severe diverticulitis; NSD, non-severe diverticulitis; NS, not significant; BMI, body mass index; CT, computed tomography; VAT, visceral adipose tissue; SAT, subcutaneous adipose tissue; TAT, total abdominal adipose tissue; WBC, white blood cell.

*Available number of patients, 172 (severe, 22; non-severe, 150).
patients (4.7%) suffered from recurrent diverticulitis. Twenty-four patients (12.6%) were diagnosed as SD, and perforation (n=16, 66.7%) was the most common complication. Eleven patients (5.8%) underwent surgery because of complications. The baseline characteristics of the study population are summarized in Table 1.

2. Patients’ characteristics according to the severity of diverticulitis

The characteristics of subjects between SD and non-severe diverticulitis (NSD) are compared in Table 2. Of 190 subjects, there were 24 (12.6%) patients with SD and 166 (87.4%) patients with NSD. Compared to those with NSD, patients with SD had significant relationships with older age (49.1±14.9 vs 38.5±12.7, p<0.005), fever over 38.3°C (n=7 [29.2%] vs n=17 [10.2%], p=0.017) and bowel habit change (n=7 [29.2%] vs n=19 [11.4%], p=0.027). Of anthropometric measurements of obesity, we found that only VAT/TAT was significantly higher in the SD group (48.8±12.6 vs 40.0±12.6, p=0.002), whereas BMI and WC did not significantly differ between the two investigated groups. Moreover, there was no significant difference in other factors, such as sex, smoking, leukocytosis, range and number of diverticula, comorbidity, chronic constipation, nausea, vomiting, tenderness, rebound tenderness, and recurrence between SD and NSD groups.

3. The risk factors for severe diverticulitis

The results of multivariate analysis are presented in Table 3. The statistical significance was shown in age over 40 years (odds ratio [OR], 3.2; 95% confidence interval [CI], 1.104 to 9.237; p=0.032), male (OR, 4.0; 95% CI, 1.237 to 13.183; p=0.021), and left-sided diverticulitis (OR, 6.2; 95% CI, 1.382 to 28.086; p=0.017). However, obesity-associated factors like BMI, WC, and fat measurements by CT scan were not significantly related to the severity. Moreover, despite the significant relationship with the location of diverticulitis and severity, the range and number of diverticula were not associated with the severity of acute diverticulitis.

4. Patients’ characteristics according to the location of diverticulitis

Table 4 shows patients’ characteristics according to the location of diverticulitis, comparing right and left-sided diverticulitis. There were 175 (92.1%) patients with right-sided diverticulitis and 15 (7.9%) patients with left-sided diverticulitis. Right-sided diverticulitis had significant relationships with younger age (38.2±11.8 vs 59.0±16.9), lower VAT/TAT (48.8±12.6 vs 50.8±9.0), shorter WC (81.0±8.6 vs 88.6±8.4), lesser comorbidity, lesser bowel habit change and NSD. However, obesity parameters were not statistically significant when adjusted by age. Eventually, surgical interventions were required less frequently in the right-sided diverticulitis and the patients stayed shorter in the hospital.

DISCUSSION

The purpose of this study was to investigate the prognostic factors of acute diverticulitis in Korea and to identify difference

| Characteristic                  | Frequency of patients with SD within each subgroup | OR    | 95% CI       | p-value |
|-------------------------------|---------------------------------------------------|-------|--------------|---------|
| Age >40yr                      | 18/85 (21.2)                                      | 1.94  | 1.040-3.584  | 0.032   |
| Male                          | 17/101 (16.8)                                     | 1.03  | 0.591-1.792  | 0.932   |
| Obesity                       |                                                   |       |              |         |
| BMI >30, kg/m²                 | 2/8 (25.0)                                        | 1.85  | 0.897-3.844  | NS      |
| Waist circumference, cm*       | 82.8±7.9                                         | 0.964 | 0.897-1.030  | NS      |
| VAT/TAT, %*                   | 48.8±12.6                                        | 1.040 | 0.978-1.054  | NS      |
| Smoking                       | 9/78 (11.5)                                       | 0.603 | 0.474-0.770  | NS      |
| Left-sided diverticulitis      | 6/15 (40.0)                                       | 0.463 | 0.199-1.097  | NS      |
| Range of diverticula (pan-colon) | 2/35 (5.7)                                   | 0.227 | 0.040-1.282  | NS      |
| No. of diverticula (multiple)  | 16/126 (12.7)                                     | 0.805 | 0.283-2.286  | NS      |
| Comorbidity                   | 7/32 (21.9)                                       | 1.521 | 0.447-5.179  | NS      |
| Chronic constipation           | 1/7 (14.3)                                        | 0.677 | 0.068-6.747  | NS      |
| Recurrence                    | 2/9 (22.2)                                        | 2.340 | 0.395-13.848 | NS      |

Data are presented as mean±SD or number (%).
SD, severe diverticulitis; OR, odds ratio; CI, confidence interval; BMI, body mass index; NS, not significant; VAT, visceral adipose tissue; TAT, total abdominal adipose tissue.
*Available number of patients, 172 (severe, 22; non-severe, 150).
on CT or pathologic report, but also clinical manifestation, such as sepsis or peritonitis requiring emergency operation. Although there have been controversies, the reported risk factors of SD are different between Western and Asian societies. In Western countries, younger age, gender, obesity, smoking, recurrence, and comorbidity have been reported as risk factors of SD. However, it is not clear whether the relationship of these factors to the complicated diverticulitis in Asian countries is equal when compared to that of Western countries. From this point, this study provides informative clue about this question despite relatively small number of patients. Although, in the many studies from Korea, age, sex, and location of diverticulitis have been evaluated, there is few study performing extensive investigation of variable risk factor of SD. We directly compared the clinical factors between non-SD and SD handling risk factors not only that are already suggested in Korea but also that are unknown or potential including obesity, smoking, range and number of diverticula, comorbidity, bowel habit change, and recurrence.

It was suggested that, in Western countries, most diverticula are located in the sigmoid colon. The lack of dietary fiber and consequent increase in intraluminal pressure of the colon are believed to be important etiological factors, which seem to be determined by mixed factors, such as lifestyle, constipation and irritable bowel syndrome. They are acquired over time with increasing age and multiple and false diverticula in which herniation involve only the mucosal and submucosal layer. On the contrary, in Asian countries, most diverticula are located on the right colon around the cecum, and they seem to be congenital, isolated and true diverticula. In agreement with this study, left-sided location of diverticulitis has been consistently reported as a significant risk factor of SD, and poor outcome even in patients who underwent surgery in Asia. In addition to the prognostic aspect, different characteristics with respect to age, premorbidity, rate of perforation and obesity were reported according to the location of diverticulitis in Asia. Although the reason why left-sided location is virulent factor is not clear, it could be plausible that advanced age, concomitant medical conditions and higher rate of perforation leading to generalized peritonitis, which may be due to false diverticula without any muscle layer might adversely affect the clinical course of left-sided diverticulitis. In this study, right-sided diverticulitis was predominant (92.1% of total patients), similar to results from other Asian studies, even in patients with both-sided diverticula. This finding suggests that the development of right or left-sided diverticulitis might mainly result from the genetic difference. On the other hand, in Western country where left-sided diverticulitis is predominant, there are some reports that right-sided diverticulitis is associated with higher rate of complication. Moreover, in contrast to recommendations for left-sided diverticulitis with respect to age and frequency of attack, conservative medical therapy of uncomplicated diverticulitis is effective due to the benign and self-limited natural...

### Table 4. Patients Characteristics according to the Location of Diverticulitis

| Characteristic               | Right-sided diverticulitis (n=175, 92.1%) | Left-sided diverticulitis (n=15, 7.9%) | p-value |
|-----------------------------|------------------------------------------|--------------------------------------|---------|
| Age, yr                     | 38.2±11.8                                | 59.0±16.9                            | <0.001  |
| Male                        | 91 (53.1)                                | 8 (53.3)                             | NS      |
| Obesity                     |                                          |                                      |         |
| BMI, kg/m²                  | 23.0±3.4                                 | 24.7±3.2                             | NS      |
| Waist circumference, cm*    | 81.0±8.6                                 | 88.6±8.4                             | 0.002   |
| CT measurement*             |                                          |                                      |         |
| VAT, cm²                    | 103.1±50.7                               | 177.8±71.3                           | <0.001  |
| SAT, cm²                    | 150.7±64.7                               | 163.2±41.2                           | NS      |
| TAT, cm²                    | 253.8±94.1                               | 341.1±99.2                           | 0.002   |
| VAT/TAT, %                  | 40.3±12.8                                | 50.8±9.0                             | 0.004   |
| Smoking                     | 73 (41.7)                                | 5 (33.3)                             | NS      |
| Fever (≥38.3°C)             | 21 (12.0)                                | 3 (20.0)                             | NS      |
| Leukocytosis (WBC >10,000/m³) | 132 (75.4)                             | 10 (66.7)                            | NS      |
| No. of diverticula (single/multiple) | 59 (33.7)                             | 5 (33.3)                             | NS      |
| Comorbidity                 | 25 (14.3)                                | 7 (46.7)                             | 0.005   |
| Chronic constipation        | 6 (3.4)                                  | 1 (6.7)                              | NS      |
| Bowel habit change          | 21 (12.0)                                | 5 (33.3)                             | 0.037   |
| Nausea/Vomiting             | 20 (11.4)                                | 2 (13.3)                             | NS      |
| Tenderness/Rebound tenderness | 175/110                                | 14/9                                 | NS/NS   |
| Recurrence                  | 9 (5.1)                                  | 0 (0.0)                              | NS      |
| Severe diverticulitis       | 18 (10.3)                                | 6 (40.0)                             | 0.005   |
| Requiring operation         | 6 (3.4)                                  | 5 (33.3)                             | 0.001   |
| Hospital days               | 7.5±4.1                                  | 16.2±22.8                            | 0.044   |

Data are presented as mean±SD or number (%). NS, not significant; BMI, body mass index; CT, computed tomography; VAT, visceral adipose tissue; SAT, subcutaneous adipose tissue; TAT, total abdominal adipose tissue; WBC, white blood cell. *Available number of patients, 172 (right-sided diverticulitis, 159; left-sided diverticulitis, 13); †Variables were not statistically significant when adjusted by age.
history of right-sided diverticulitis. The difference in the predominant location of diverticulitis (with its accompanying characteristics and natural course) between the Asian and Western countries supports the hypothesis that a unique spectrum of disease, with its own pathogenesis, may be present within specific ethnic groups. Therefore, a different treatment guideline for Asian diverticulitis, where the right-sided location is predominant, seems to be required. Considering the less aggressive course of the right-sided diverticulitis, following the treatment guideline of Western studies might lead to the overtreatment of acute diverticulitis in Asia. Medical treatment seems enough to manage the acute diverticulitis in Asia, but special consideration may be required for patients with older age and left-sided diverticulitis.

Although this view is still under considerable debate in Western countries, historically, younger patients were supposed to show a more aggressive and fulminant course of the disease and the treatment guideline reflected this idea by recommending more aggressive treatment in those cases. Meanwhile, in Korea, although several studies showed that age factor is not a significant risk factor of SD requiring surgical therapy, some studies including this study suggested older age is an independent risk factor of complicated diverticulitis regardless of location of diverticulitis and comorbidity. Further large scaled studies would be needed to confirm this finding.

Although, historically, younger patients with complicated diverticulitis tend to be male, gender as a predictive factor is controversial. Most studies presented no preponderance of certain gender, but some Western studies reported females were significantly associated with complicated diverticulitis disease and poor prognosis. Meanwhile, in Asian population, the multivariate analysis of our study showed that males were likely to have SD. Although no case control study in Asian population reported male as a statistically significant risk factor of SD, male predominance was reported in several studies of patients who underwent surgery. These findings suggest that relatively small number of patients who are included in SD group might lead to a statistical insignificance of sex distribution as a virulent factor in Asia where right-sided diverticulitis is predominant. Further large scaled study including large number of patients who have left-sided diverticulitis would be needed for the clarification of this question.

Obesity is a growing health concern worldwide. Although the mechanism by which obesity contributes to the development of acute diverticulitis is not completely understood, several studies from Western society using anthropometric measurements of obesity, such as BMI and WC, have suggested that obesity may have a relationship not only with the development of acute diverticulitis, but also with the higher rate of complications and recurrence. However, it is still controversial whether obesity increases severity. To the best of our knowledge, just one report which include relatively small number of patients using only single obesity parameter, BMI, has been published regarding the relationship between obesity and the severity of the diverticular disease in Asians. In addition, direct measurement of abdominal adipose tissue using CT scan has never been used to evaluate the relationship between obesity and SD in the literature until now. In this study, not only BMI and WC, but also fat measurement by CT scan (which is the gold standard for the measurement of visceral obesity) was used to evaluate the degree and subtype of obesity. Although, as a result, the proportion of visceral adipose tissue was significantly associated with SD in the univariate analysis, various measurements of obesity including BMI, WC, VAT, and VAT/TAT were not significantly associated with SD in the adjusted analysis in accordance with previous Korean study. This finding might suggest the possibility of difference in the pathogenesis of diverticulitis between two ethnic groups and additional studies focusing on the significance of obesity as a virulent factor of diverticulitis in Korea where obesity prevalence is relatively low compared to Western population would be needed.

In the literature, the reported recurrence rate of right-sided diverticulitis was 12.6% to 60% after medical treatment, and that of left-sided diverticulitis was 7% to 45%. However, because of the small number of patients with recurrent diverticulitis in this study (n=9, 4.7%), it might not be reasonable to evaluate the relationship between recurrence and SD here. There also have been reports about smoking as a risk factor of complicated diverticulitis of the sigmoid colon. However, we could not find any statistically significant difference between complicated and uncomplicated groups in this study. Although there is strong evidence that a reduced intake of insoluble dietary fiber is associated with an increased risk of diverticulitis, chronic constipation resulting from reduced dietary fiber was not associated with complicated diverticulitis in this study. Comorbidity, measured by the Charlson score, was suggested as a major determinant of severity in acute diverticulitis. Some also reported certain comorbid conditions, such as hypoalbuminemia, chronic obstructive pulmonary disease and glucocorticoid use, might predispose patients to recurrent or complicated attacks of diverticulitis requiring colectomy. However, we could not find the significance of comorbidity as a determinant of severity, but it is possibly because most patients in this study had less severe comorbid conditions, like uncomplicated diabetes and/or hypertension, according to the Charlson scores.

The weakness of the present study was that patients included were only inpatients, and outpatients with mild diverticulitis were not included, so it was limited in representing the clinical characteristics of the whole cohort of patients diagnosed with diverticulitis. Moreover, there is a possibility that some patients might have not been followed up, and therefore some cases of recurrent diverticulitis might have been missed. In addition, because this study was a single center study, it might be also limited to evaluate and represent the clinical characteristics and
risk factors of SD in Korea as a whole, even taking into account the comparable incidence of SD published in the other report. In conclusion, the risk factors of SD in Korea are different from those of Western countries. Our study suggests that the risk factors of SD in Korea are age over 40 years, male and left-sided diverticulitis. We can assume that it resulted from the different etiology and clinical spectrum according to the predominant location of diverticulitis. Therefore, different strategy for the treatment of diverticulitis seems to be needed in Korea.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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