



Clinical outcome for management of colonic diverticulitis: characteristics and surgical factor based on two institution data at South Korea

Dae Ro Lim¹ · Jung Cheol Kuk¹ · Eung Jin Shin¹ · Hyuk Hur² · Byung Soh Min² · Kang Young Lee² · Nam Kyu Kim²

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Abstract

Purpose The aim of this study was to analyze clinical outcomes after surgical and/or conservative management of patients with colonic diverticulitis.

Material and methods Between January 2001 and November 2018, data for 1175 patients (right (Rt.) side: $n = 1037$, left (Lt.) side: $n = 138$) who underwent conservative management ($n = 987$) and surgical management ($n = 188$) for colonic diverticulitis were retrieved from a retrospective database. The Rt. sided was defined up to the proximal two-thirds of the transverse colon and Lt. sided was defined from the distal one-third of the transverse colon.

Results The overall incidence of colonic diverticulitis is gradually increasing. The mean age of all patients was 43.2 ± 17 and was significantly higher in patients with Lt.-sided (57.0 ± 15.7) than with Rt.-sided (41.4 ± 13.4) diverticulitis ($p = 0.001$). The most common lesion site was cecum (71.7%, $n = 843$). First-time attacks were the most common (91.0%, $n = 1069$). The surgical rate was 12.2% on the right. sided and 44.9% on the left sided ($p < 0.005$). The mean age, age distribution, BMI, open surgery rate, stoma formation rate, and Hinchey types III and IV rate were significantly higher in Lt. sided than in Rt. sided ($p < 0.005$). Older age, higher BMI (≥ 25), and Hinchey types III and IV were significantly associated with surgical risk factors of diverticulitis ($p < 0.005$).

Conclusion Base on present study, Lt.-sided colonic diverticulitis tends to be more severe than Rt. sided, and surgery is more often required. In addition, colonic diverticulitis that requires surgery seems to be older and more obese on Lt. sided.

Keywords Colonic diverticulitis · Surgery · Conservative management

Introduction

Colonic diverticulosis refers to a small outpouching of the intestinal wall. It is classified histologically as a true diverticulum when all layers of the bowel wall protrude or as a false diverticulum when only the mucosal and submucosal layers protrude through the muscular layer [1]. Colonic diverticulosis is common in the Western

population and is mainly present in the sigmoid colon, whereas it is less common in Asian populations, including South Koreans, and is mainly present in the right-sided colon [2–4]. Although colonic diverticulosis is usually asymptomatic, 10–20% of colonic diverticulosis can develop into colonic diverticulitis [5].

Recently, the prevalence of colonic diverticulosis has been increasing in South Korea, as has the incidence of colonic diverticulitis since the 1990s [2, 6]. Uncomplicated colonic diverticulitis can be treated with nonsurgical management (conservative management and antibiotic therapy), whereas complicated colonic diverticulitis that includes perforation, abscess, purulent or feculent peritonitis, fistula, stricture, and obstruction may sometimes require surgical treatment [7, 8]. The aim of the present study was to analyze the clinical characteristics and outcomes after surgical and/or conservative management in South Korean patients with acute colonic diverticulitis.

✉ Nam Kyu Kim
namkyuk@yuhs.ac

¹ Division of Colon and Rectal Surgery, Department of Surgery, Soonchunhyang University College of Medicine, Soonchunhyang University Bucheon Hospital, Bucheon, South Korea

² Division of Colon and Rectal Surgery, Department of Surgery, Yonsei University College of Medicine, Seoul, South Korea

Material and methods

Between January 2001 and November 2018, 1175 patients who underwent management after admission to two South Korean hospitals (Severance Hospital and Sooncheonhyang Bucheon Hospital) were identified from a retrospective database. The patients with small bowel diverticulitis, with colonic diverticulitis with bleeding, and with malignancy were excluded from the present study. Of the remaining patients, 987 had undergone conservative management, including percutaneous drain catheter insertion for abscess drainage after admission, and 188 patients had undergone surgical management. All data for clinical and pathological features were reviewed retrospectively. All patients underwent abdominal pelvic CT scans and, occasionally, colonoscopy, biopsy, and abdomen ultrasound. Complicated colonic diverticulitis was defined as attacks that included obstruction, fistula, abscess, and free perforation causing either purulent or feculent peritonitis. Colonic diverticulitis found in the cecum, the ascending colon, and the hepatic flexure was classified as right sided, whereas diverticulitis found in the splenic flexure, the descending colon, and the sigmoid colon was classified as left sided. Conservative management included intravenous broad-spectrum antibiotic therapy for 1–2 weeks, with no food by mouth and fluid support and/or interventional catheter insertion for abscess drainage. Patients received follow-up and were recorded on a database until death or until May 2019.

Statistical analysis

All statistical analyses were performed using SAS Version 9.1.3 (SAS Institute Inc., Cary, NC) and SPSS software, Version 24.0 (SPSS, Chicago, IL). Categorical variables were analyzed using the χ^2 or Fisher's exact test, and continuous variables were analyzed using Student's *t* test/Mann-Whitney *U* rank tests. The association between the risk factors and colonic diverticulitis surgery was analyzed using unconditional logistic regression models. *p* values less than 0.05 were considered statistically significant.

Results

Characteristics of patients with colonic diverticulitis

The mean age of all patients in the present study was 43.2 ± 17.9 years. The study population included 679 (57.8) males and 496 (42.2%) females with a mean weight of 65.6 ± 12.8 kg, mean height of 165.8 ± 8.7 cm, and mean body mass index (BMI) of 23.8 ± 3.6 kg/m². The patient characteristics were analyzed by comparing the conservative management (*n* = 987) and surgical management (*n* = 188) groups (Table 1).

The mean age was significantly higher in the surgical management group than in the conservative management group (47.8 ± 17.9 vs. 42.3 ± 13.6 years, *p* < 0.005). The sex ratio, height, weight, and BMI did not differ significantly between the two groups. Patient characteristics were also analyzed by comparing right-sided (*n* = 1037) versus left-sided (*n* = 138) diverticulitis (Table 2). The mean age was significantly higher in patients with left-sided (57.0 ± 15.7 years) than with right-sided (41.4 ± 13.4 years, *p* = 0.001) diverticulitis. The BMI was significantly higher in patients with left-sided (24.5 ± 4.2 kg/m²) than with right-sided (23.7 ± 3.6 , *p* = 0.021) diverticulitis (Table 2).

Incidence of colonic diverticulitis

The overall incidence of colonic diverticulitis increased gradually during the present study. The yearly incidence of hospitalized colonic diverticulitis patients and the numbers of patients in the conservative management group gradually increased, whereas the numbers of patients in the surgical management group were relatively steady (Fig. 1a). The numbers of patients with right-sided colonic diverticulitis gradually increased and the numbers of patients with left-sided colonic diverticulitis were relatively steady (Fig. 1b).

Age distribution

Patients in the conservative management group showed a bell-shaped age distribution, while patients in the surgical management group showed an even ranking (*p* < 0.005). The most common age distribution was the 3rd decade (31–40 years: 27.3%, *n* = 269) and 4th decade (41–50 years: 26.4%, *n* = 261) for the conservative management group, whereas the age distribution showed an even spread in the surgical management group, as follows: 2nd (21–30 years: 13.8%, *n* = 26), 3rd (31–40 years: 17.0%, *n* = 32), 4th (41–50 years: 20.2%, *n* = 38), 5th (51–60 years: 15.9%, *n* = 31), 6th (61–70 years: 15.4%, *n* = 29), 7th (71–80 years: 8.0%, *n* = 15), and > 8th (*n* = 6, 3.2) decades (Fig. 2a).

Comparison of the right-sided and left-sided colonic diverticulitis revealed the most common age distributions as the following: 3rd (31–40 years: 27.6%, *n* = 286) and 4th (41–50 years: 26.2%, *n* = 272) decades for right-sided colonic diverticulitis, and 5th (51–60 years: 21.7%, *n* = 30) and 4th (41–50 years: 21.7%, *n* = 30) decades for left-sided colonic diverticulitis (*p* < 0.005) (Fig. 2b).

The most common age distribution in patients in the conservative management group with right-sided colonic diverticulitis was the 3rd (31–40 years: 28.3%, *n* = 257) and 4th (41–50 years: 27.0%, *n* = 246) decades. For left-sided colonic diverticulitis, the most common age distribution was the 5th (51–60 years: 30.3%, *n* = 23) and 4th (41–50 years: 23.7%, *n*

Table 1 Patient characteristics of diverticulitis ($n = 1175$)

	Total patients ($n = 1175$)	Conservative management ($n = 987$) (%)	Surgical management ($n = 188$) (%)	p value
Age (mean \pm SD (range)) (year)	43.2 \pm 14.5 (11–95)	42.3 \pm 13.6 (11–87)	47.8 \pm 17.9 (13–95)	< 0.005
Sex, n (%)				0.236
Male	679 (57.8%)	563 (57.0%)	116 (61.7%)	
Female	496 (42.2%)	424 (43.0%)	72 (38.3%)	
Weight (mean \pm SD (range)) (kg)	65.6 \pm 12.8 (36.2–123.3)	66.0 \pm 12.8 (36.4–123.0)	63.4 \pm 12.4 (36.2–108.0)	0.446
Height (mean \pm SD (range)) (cm)	165.8 \pm 8.7 (140.0–186.0)	165.8 \pm 8.6 (140.0–186.0)	165.7 \pm 9.0 (146.0–184.0)	0.610
BMI (mean \pm SD (range)) (kg/m ²)	23.8 \pm 3.6 (13.5–39.9)	23.9 \pm 3.6 (15.4–39.9)	23.0 \pm 3.7 (13.5–34.1)	0.709
Site of lesion, n (%)				
Right-sided colon	1037 (88.3%)	911 (92.3%)	126 (67.0%)	< 0.005
Cecum	843 (71.7%)	732 (74.2%)	111 (59.0%)	
Mid ascending colon	90 (7.7%)	79 (8.0%)	11 (5.9%)	
Hepatic flexure	104 (8.6%)	100 (10.1%)	4 (2.1%)	
Left-sided colon	138 (11.7%)	76 (7.7%)	62 (33.0%)	
Splenic flexure	1 (0.1%)	1 (0.1%)	0 (0.0%)	
Descending colon	40 (3.4%)	29 (2.9%)	11 (5.9%)	
Sigmoid colon	97 (8.3%)	46 (4.7%)	51 (27.1%)	
Number of attack				0.136
1	1069 (91.0%)	907 (91.9%)	161 (85.6%)	
2	77 (6.6%)	59 (6.0%)	17 (9.0%)	
3	24 (2.0%)	17 (1.7%)	7 (3.7%)	
4	4 (0.3%)	3 (0.3%)	1 (0.5%)	
5	1 (0.1%)	1 (0.1%)	0 (0.0%)	

= 18) decades ($p < 0.005$) (Fig. 2c). The most common age distribution in patients in the surgical management group with right-sided colonic diverticulitis was the 3rd (31–40 years: 23.0%, $n = 29$) and 4th (41–50 years: 23.0%, $n = 29$) decades. For left-sided colonic diverticulitis, the most common age distribution was the 6th (61–70 years: 30.6%, $n = 19$) and 7th (71–80 years: 16.1%, $n = 10$) decades ($p < 0.005$) (Fig. 2d).

Distribution of lesions

Overall, 88.3% ($n = 1037$) of the patients had right-sided diverticulitis and 11.7% ($n = 138$) had left-sided diverticulitis (Table 1). The occurrence of right-sided diverticulitis was statistically more common than left-sided diverticulitis ($p < 0.005$). In all colonic diverticulitis, the distribution of lesions in right-sided colonic diverticulitis was 71.7% ($n = 843$) in the

Table 2 Patient characteristics of right-sided and left-sided diverticulitis

	Right-sided diverticulitis ($n = 1037$) (%)	Left-sided diverticulitis ($n = 138$) (%)	p value
Age(mean \pm SD (range)) (year)	41.4 \pm 13.4 (11–87)	57.0 \pm 15.7 (15–95)	0.001
Sex, n (%)			0.936
Male	602 (57.8%)	77 (54.5%)	
Female	439 (42.2%)	57 (42.5%)	
Weight (mean \pm SD (range)) (kg)	65.5 \pm 12.8 (36.2–123.0)	66.1 \pm 12.9 (40.0–108.0)	0.866
Height (mean \pm SD (range)) (cm)	165.9 \pm 8.6 (140.0–185.0)	164.1 \pm 9.6 (141.0–186.0)	0.045
BMI (mean \pm SD (range)) (kg/m ²)	23.7 \pm 3.6 (13.5–39.9)	24.5 \pm 4.2 (14.7–39.1)	0.021
Number of attack			0.047
1	957 (91.9%)	113 (84.3%)	
2	62 (6.0%)	14 (10.4%)	
3	18 (1.7%)	6 (4.6%)	
4	3 (0.3%)	1 (0.7%)	
5	1 (0.1%)	0 (0.0%)	

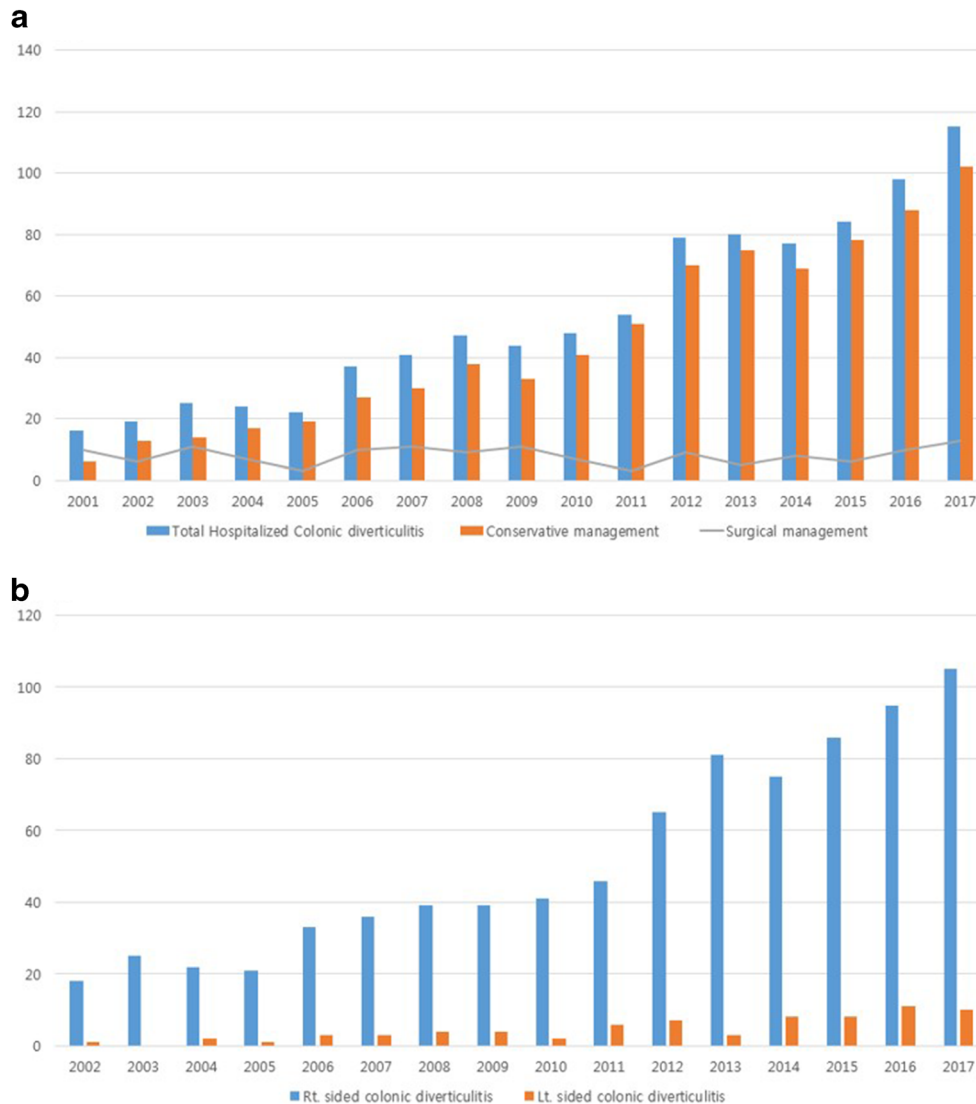
cecum, 7.7% ($n = 90$) in the ascending colon, and 8.6% ($n = 104$) in the hepatic flexure. The cecum was the most common site of lesions in right-sided colonic diverticulitis. In all colonic diverticulitis, distribution of lesions in left-sided colonic diverticulitis was 8.3% ($n = 97$) in the sigmoid colon, 3.4% ($n = 40$) in the descending colon, and 0.1% ($n = 1$) in the splenic flexure. The conservative management group had 92.3% ($n = 911$) right-sided and 7.7% ($n = 76$) left-sided colonic diverticulitis, with the following lesion distributions: 71.7% ($n = 843$) in the cecum, 7.7% ($n = 90$) in the ascending colon, and 8.6% ($n = 104$) in the hepatic flexure for right-sided diverticulitis and 4.7% ($n = 46$) in the sigmoid colon, 2.9% ($n = 29$) in the descending colon, and 0.1% ($n = 1$) in the splenic flexure for left-sided diverticulitis. The surgical management group had 67.0% ($n = 126$) right-sided and 33.0% ($n = 62$) left-sided cases of colonic diverticulitis, with the following lesion distributions: 59.0% ($n = 111$) in the cecum, 5.9% ($n = 11$) in the ascending colon, and 2.1% ($n = 4$) in the hepatic

flexure for right-sided diverticulitis and 27.1% ($n = 51$) in the sigmoid colon, 5.9% ($n = 11$) in the descending colon, and 0% ($n = 0$) in the splenic flexure for left-sided diverticulitis.

Number of attacks

The most common number of attacks in the patient population was one (91.0%, $n = 1069$), followed by two (6.6%, $n = 77$), three (2.0%, $n = 24$), four (0.3%, $n = 4$), and five (0.1%, $n = 1$) (Table 1). The conservative management group had the following attack incidence: one (91.9%, $n = 907$), two (6.0%, $n = 59$), three (1.7%, $n = 17$), four (0.3%, $n = 3$), and five (0.1%, $n = 1$). The surgical management group had the following attack incidence: one (85.6%, $n = 161$), two (9.0%, $n = 17$), three (3.7%, $n = 7$), four (0.5%, $n = 1$), and five (0%, $n = 0$) ($p = 0.136$). The attack incidence for right-sided colonic diverticulitis was as follows: one (91.9%, $n = 957$), two (6.0%, $n = 62$), three (1.7%, $n = 18$), four (0.3%, $n = 3$), and five (0.1%, $n = 1$).

Fig. 1 Yearly incidence of hospitalized colonic diverticulitis patients. **a** Annual increase in patients of hospitalized colonic diverticulitis, while steady trend of patients in surgical management group. **b** Annual increase in patients of hospitalized Rt.-sided and Lt.-sided colonic diverticulitis



The attack incidence for left-sided colonic diverticulitis was as follows: one (84.3%, $n = 113$), two (10.4%, $n = 14$), three (4.6%, $n = 6$), four (0.7%, $n = 1$), and five (0%, $n = 0$) ($p = 0.047$) (Table 2).

Surgical treatment of patients with colonic diverticulitis

The surgery was performed in 126 of 1037 patients with right-sided diverticulitis, accounting for 12.2%, while the surgery was performed in 62 of 138 patients with left-sided diverticulitis, accounting for 44.9% ($p < 0.005$). Patients with right-sided colonic diverticulitis who underwent surgical management ($n = 126$) showed rates of cecal wedge resection of 38.9% ($n = 49$), bowel resection of 31.7% ($n = 40$), primary repair of 0.8% ($n = 1$), and appendectomy of 28.6% ($n = 36$). Patients with left-sided colonic diverticulitis who underwent surgical management ($n = 62$) showed rates of bowel resection of 93.6% ($n = 58$), primary repair of 3.2% ($n = 2$), and subtotal colectomy of 3.2% ($n = 2$) (Table 3). Stoma formation occurred most frequently in left-sided colonic diverticulitis, with a rate of 46.7% ($n = 28$) in left-sided colonic diverticulitis with surgical management versus 0.8% ($n = 1$) in right-sided colonic diverticulitis with surgical management ($p < 0.005$). The anastomosis rate after bowel resection was significantly lower in left-sided colonic diverticulitis, with a rate of 100% ($n = 40$) in right-sided and 46.7% ($n = 28$) in left-sided colonic diverticulitis ($p < 0.005$). The open surgery rate was significantly higher for left-sided (81.4%, $n = 48$) than for right-sided (59.7%, $n = 77$) colonic diverticulitis ($p = 0.003$). The

laparoscopic surgery rate was significantly higher for right-sided (40.3%, $n = 52$) than for left-sided (18.6%, $n = 11$) colonic diverticulitis ($p = 0.003$).

Hinchey classification of patients with colonic diverticulitis

The conservative management group showed Hinchey classification type I as the most common classification for both right-sided (97%, $n = 884$) and left-sided (90.5%, $n = 68$) colonic diverticulitis. The incidence of type II was 2.6% ($n = 24$) and type III was 0.4% ($n = 4$) for right-sided colonic diverticulitis, whereas the incidence of type II was 9.4% ($n = 7$) and type III was 0% for left-sided colonic diverticulitis. The surgical management group showed types III and IV as significantly more common in left-sided than in right-sided colonic diverticulitis ($p < 0.005$). The incidence of type IV was 61.3% ($n = 38$) in left-sided and 7.1% ($n = 9$) in right-sided colonic diverticulitis. The incidence of type III was 30.6% ($n = 19$), II was 3.2% ($n = 2$), Ib was 1.6% ($n = 1$), and Ia was 3.2% ($n = 2$) in left-sided colonic diverticulitis, whereas the incidence of type III was 13.5% ($n = 17$), II was 17.5% ($n = 22$), Ib was 20.6% ($n = 26$), and Ia was 41.2% ($n = 52$) for right-sided colonic diverticulitis (Table 4).

Risk factor for surgery of colonic diverticulitis

Older age (OR, 0.972; 95% CI, 0.953 to 0.991), high BMI (≥ 25) (OR, 1.745; 95% CI, 1.026 to 2.996), and Hinchey classification types III and IV (OR, 0.002; 95% CI, 0.000 to 0.010) were

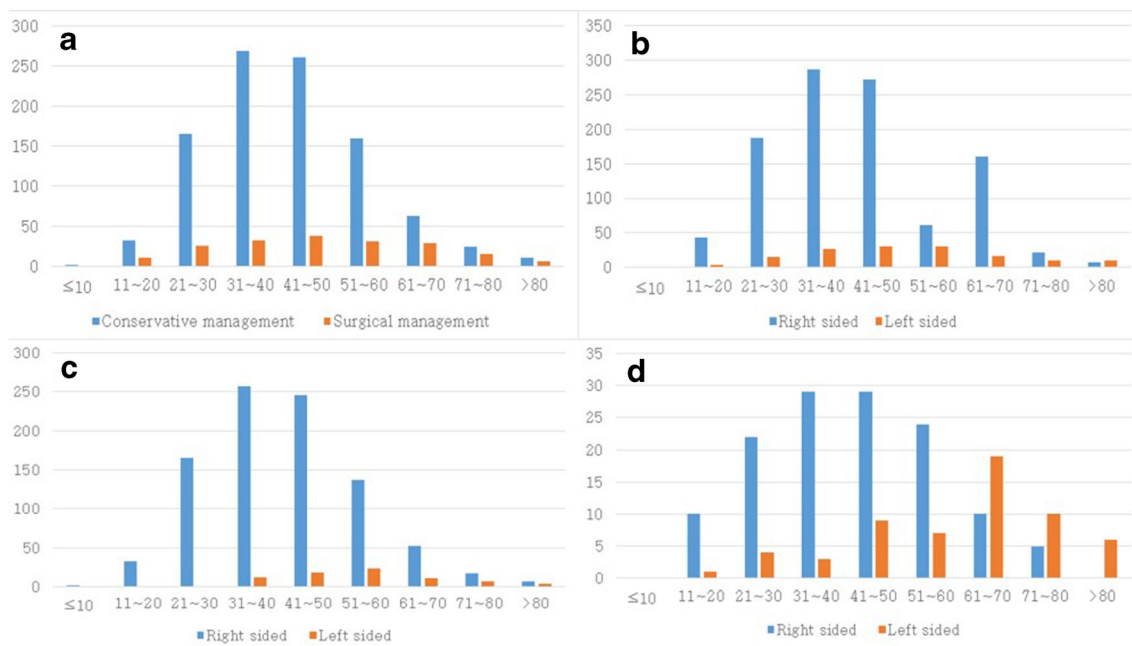


Fig. 2 Age distribution of colonic diverticulitis patients. **a, b** Total colonic diverticulitis patient. **c** Colonic diverticulitis in conservative management group. **d** Colonic diverticulitis in surgical management group

Table 3 Surgical treatment of diverticulitis patients

	Right-sided diverticulitis (<i>n</i> = 126) (%)	Left-sided diverticulitis (<i>n</i> = 62) (%)	<i>p</i> value
Operation			NS
Cecal wedge resection	49 (38.9%)	0 (0.0%)	
Resection of bowel	40 (31.7%)	58 (93.6%)	
Primary repair	1 (0.8%)	2 (3.2%)	
Subtotal colectomy	0 (0.0%)	2 (3.2%)	
Appendectomy	36 (28.6%)	0 (0.0%)	
Stoma formation			< 0.005
Yes	1 (0.8%)	30 (48.4%)	
No	125 (99.2%)	32 (51.6%)	
Anastomosis after resection of bowel			< 0.005
Yes	40 (100.0%)	28 (46.7%)	
No	0 (0.0%)	32 (53.3%)	
Operation method			0.003
Open surgery	77 (59.7%)	48 (81.4%)	
Laparoscopic surgery	52 (40.3%)	11 (18.6%)	

associated with an increased risk of surgery for colonic diverticulitis ($p < 0.005$). Underlying medical disease, sex, number of attacks, and locations of lesions were not associated with a need for surgery for colonic diverticulitis (Table 5).

Discussion

In previous South Korean studies, the mean age of surgical patients with symptomatic colonic diverticulitis was 57.2 years (range 19–87 years), and the largest number of patients was in the 60–69 years age group [9]. In addition, the mean age was significantly higher in surgical patients with left-sided than with right-sided colonic diverticulitis [9]. In the present study, the mean age of the surgical patients with colonic diverticulitis was 47.8 years (range 13–95), and the mean age was significantly higher for surgical patients with left-sided than with right-sided

colonic diverticulitis (left-sided 57.0 years vs. right-sided 41.4 years, $p = 0.001$). The reason for the relatively older age of left-sided diverticulitis patients requiring surgical management is unknown.

Colonic diverticulitis is now mainly diagnosed by computed tomography (CT). The CT scan with intravenous and oral contrast has a reported sensitivity of 98% and a specificity of 99% and has become a standard in the evaluation of suspected acute colonic diverticulitis [8–10]. CT scan findings of colonic diverticulitis include thickening of fascial planes, pericolic fat stranding, colonic wall thickening, the presence of an extraluminal mass, and an inflamed diverticulum. Therefore, CT scanning is very useful for evaluating the Hinchey classification used to identify the severity of colonic diverticulitis [10]. All colonic diverticulitis patients in the present study were diagnosed with CT scans, and patients who did not undergo CT were excluded from the study.

Table 4 Hinchey classification of colonic diverticulitis

	Right-sided diverticulitis	Left-sided diverticulitis	<i>p</i> value
Conservative management	<i>N</i> = 912	<i>N</i> = 75	< 0.005
1a	803 (88.1%)	61 (81.1%)	
1b	81 (8.9%)	7 (9.4%)	
2	24 (2.6%)	7 (9.4%)	
3	4 (0.4%)	0 (0.0%)	
4	0 (0.0%)	0 (0.0%)	
Surgical management	<i>N</i> = 126	<i>N</i> = 62	< 0.005
1a	52 (41.2%)	2 (3.2%)	
1b	26 (20.6%)	1 (1.6%)	
2	22 (17.5%)	2 (3.2%)	
3	17 (13.5%)	19 (30.6%)	
4	9 (7.1%)	38 (61.3%)	

Distinguishing right-sided colonic diverticulitis from appendicitis with CT can sometimes be difficult, and a large proportion of right-sided diverticulitis has been misdiagnosed as acute appendicitis because of inflammation around the cecum [11]. In particular, the presence of an abscess pocket due to microperforation creates difficulties in distinguishing whether the abscess is due to colonic diverticulitis or to appendicitis. In the present study, the surgical management group contained patients who underwent appendectomy only ($n = 36$). Some of these patients underwent surgery for abscess drainage, while others underwent a combination of surgeries for diverticulitis and appendicitis.

Previous studies indicated younger age as a risk factor for more serious diverticulitis and higher recurrence of attacks, but a more recent study showed no association between younger age and worse outcomes or higher recurrences [12, 13]. In the present study, most patients with severe colonic diverticulitis who required surgical management were relatively older (especially patients with left-sided disease). A systematic review has shown recurrence rates of 10 to 35% after a first episode of uncomplicated diverticulitis [14]. Free perforation is more likely in patients who have no history of diverticulitis than in those with a previous episode (25% vs. 12%) [15]. Most patients who have a perforation of the bowel associated with colonic diverticulitis experience the perforation during their first attack [16]. However, in the present study, the recurrent attack rate for diverticulitis was relatively low (9.0%, overall), and of those patients, a second attack occurred in only 6.6%. Most patients (over 90.0%) in the present study had only experienced a first attack, and most did not relapse after treatment of the first attack. In addition, no significant difference was noted in the attack rate for the second or more incidents between the conservative management group and surgical management group. However, the attack rate was significantly higher for patients with right-sided than with left-sided diverticulitis.

Recent studies have shown that the number of attacks is not clearly associated with complicated diverticulitis that requires surgical management [7, 17, 18]. One study reported that many patients do not have another attack after the initial attack of uncomplicated diverticulitis and that only 3–5% have a recurrence of complicated colonic diverticulitis after uncomplicated diverticulitis [18]. In the present study, most of the surgical management for colonic diverticulitis was for first attacks (85.6%). The number of attacks and the locations of the lesions were not associated with a requirement for surgery in the present study.

In Western countries, acute colonic diverticulitis is predominantly left-sided, with right-sided diverticulitis being relatively rare and appearing only in 1.5% of patients [19]. A retrospective cohort study of patients in the USA with acute colonic diverticulitis reported incidences of 72% in the sigmoid colon, 33% in the descending colon, 3% in the transverse colon, and 5% in the ascending colon [20]. In contrast to

Table 5 Risk factors for surgery of colonic diverticulitis

	OR	95% CI	<i>p</i> value
Underlying medical disease	0.888	0.439–1.798	0.742
Age	0.972	0.953–0.991	0.004
Sex			
Male versus female	0.987	0.628–1.550	0.953
BMI			
< 25 versus \geq 25	1.745	1.026–2.966	0.040
Hinchey			
1–2 versus 3–4	0.002	0.000–0.010	< 0.001
Number of attack	1.422	0.940–2.152	0.095
Location of lesion			
Right sided versus left sided	0.799	0.286–2.230	0.668

Western countries, right-sided colonic diverticulitis has a higher incidence in Asian populations, including South Koreans [21, 22]. This difference is thought to be due to environmental factors, diversity of life, and genetics, but the exact reason is not known [23].

In the present study, the incidence of diverticulitis was much higher for the right-sided than for the left-sided (88.3% vs. 11.7%) colon ($p < 0.005$). In patients with right-sided colonic diverticulitis in the present study, 71.7% had the disease in the cecum, 7.7% in the mid ascending colon, and 8.6% in the hepatic flexure.

The most commonly used staging system for colonic diverticulitis is the Hinchey classification, which was developed in 1978 and subsequently modified [24, 25]. In the present study, patients in the surgical management group with right-sided colonic diverticulitis had more Hinchey types I and II disease (79.3%), whereas patients with left-sided colonic diverticulitis had more Hinchey types III and IV (91.9%) ($p < 0.005$). In other words, left-sided colonic diverticulitis was a more severe disease than right-sided colonic diverticulitis in patients who needed surgical management. The majority of the patients in the conservative management group with right-sided (99.6%) and left-sided colonic diverticulitis (100.0%) were Hinchey types I and II. One study has reported that left-sided colonic diverticulitis frequently required a multi-stage operation and was more often associated with postoperative morbidity and mortality when compared with right-sided colonic diverticulitis because of the higher Hinchey stage of left-sided versus right-sided colonic diverticulitis [9]. Another study reported that a diverting stoma was more common in the left-sided than right-sided colonic diverticulitis (62.5% vs. 6.3%, $p < 0.001$). In addition, open surgery was more common in left-sided than in right-sided colonic diverticulitis (90.6% vs. 71.9%), although the difference was not statistically significant [26]. In the present study, the surgical management group showed higher Hinchey stage type, open surgery rate, and stoma formation rate for left-sided than for right-sided colonic diverticulitis.

The present study has several limitations, including its retrospective design, significant selection biases, and small sample size. Nevertheless, the findings of the present study are meaningful for the analysis and demonstration of the characteristics and surgical outcomes of patients with colonic diverticulitis in Asia, and in South Korea in particular, compared with Western patients. The present study may also be helpful for future treatment of colonic diverticulitis disease.

In conclusion, the overall incidence of colonic diverticulitis is increasing gradually in South Korea. South Koreans have a very common right-sided colonic diverticulitis, but the surgical rate is low and often treated with conservative management, but the left-sided colonic diverticulitis is not common, but the surgical rate is very high and also the severity of the lesion is high. The mean age, distribution of age, BMI, open surgery rate, stoma formation rate, and Hinchey types III and IV incidence were significantly higher in patients requiring surgical treatment for left-sided than for right-sided colonic diverticulitis. Base on present study, Lt.-sided colonic diverticulitis tends to be more severe than Rt.-sided colonic diverticulitis, and surgery is more often required. In addition, colonic diverticulitis that requires surgery seems to be older and more obese on Lt.-sided colonic diverticulitis.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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