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RESEARCH

Recurrent diverticulitis after elective surgery

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Abstract

Purpose Elective sigmoid resection is proposed as a treatment for symptomatic diverticular disease for the possible improvement in quality of life achievable. Albeit encouraging results have been reported, recurrent diverticulitis is still a concern deeply affecting quality of life. The aim of this study is to determine the rate of recurrent diverticulitis after elective sigmoid resection and to look for possible perioperative risk factors.

Methods Patients who underwent elective resection for DD with at least a 3-year follow-up were included. Postoperative recurrence was defined as left-sided or lower abdominal pain, with CT scan-confirmed findings of diverticulitis.

Results Twenty of 232 (8.6%) patients developed CT-proven recurrent diverticulitis after elective surgery. All the 20 recurrent diverticulitis were uncomplicated and did not need surgery. Eighty-five percent of the recurrences occurred in patients with a preoperative diagnosis of uncomplicated DD, 70% in patients who had at least 4 episodes of diverticulitis, and 70% in patients with a history of diverticulitis extended to the descending colon. Univariate analysis showed that recurrence was associated with diverticulitis of the sigmoid and of the descending colon ($p=0.04$), with a preoperative diagnosis of IBS ($p=0.04$) and with a longer than 5 years diverticular disease ($p=0.03$). Multivariate analysis was not able to determine risks factors for recurrence.

Conclusion Our study showed that patients with a preoperative diagnosis of IBS, diverticulitis involving the descending colon, and a long-lasting disease are more likely to have recurrent diverticulitis. However, these variables could not be assumed as risk factors.

Keywords Diverticulitis · Recurrence · Elective surgery · Colon surgery

Introduction

Laparoscopic elective sigmoid resection is proposed as a treatment for symptomatic diverticular disease (DD) [1]. Patients recovering from an episode of acute complicated diverticulitis might be indicated for elective surgery even though such a behavior is not widely adopted [2]. Similarly for patients suffering from acute recurrent diverticulitis, smoldering diverticulitis, or symptomatic uncomplicated

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diverticular disease (SUDD), the decision on elective surgery is taken on a tailored approach [3].

The question still remains open, whether or not to perform elective surgery for symptomatic diverticular disease. The main concern is nowadays related to the possible improvement in quality of life achievable with planned surgery. Moreover, it is desirable to be able to avoid future complicated attacks and also to prevent patients from any kind of recurrent diverticulitis [4]. However, elective surgery might be unable to fully prevent future symptomatic diverticular disease.

Therefore, it is crucial to corroborate the effectiveness of elective surgery by describing the postoperative recurrence rate of acute diverticulitis [5].

This retrospective analysis aims to determine the rate of recurrent diverticulitis after elective sigmoid resection and to look for possible perioperative risk factors.

Materials and methods

This is a retrospective analysis of a prospectively maintained single institution dedicated database. Patients with a diagnosis of diverticular disease have been prospectively enrolled in a specific database since 2013. Patients who underwent elective colon resection for DD with at least a 3-year follow-up were included in the analysis. All patients included received a preoperative CT scan reporting the presence of DD and a full colonoscopy.

Demographic data included age, gender, the American Society of Anesthesiologists (ASA) classification, smoking habits, diagnosis of irritable bowel syndrome (IBS), whether it was SUDD, smoldering DD, acute recurrent diverticulitis or complicate diverticulitis, the number of episodes of acute diverticulitis, description of the surgical operation, and pathology examination.

Smoldering diverticulitis was defined as prolonged (3 months) left lower quadrant abdominal pain associated with inflammation at the blood examination not responding to therapy with CT scan proved DD [6].

SUDD was defined as the presence of colonic diverticulosis both at CT scan and colonoscopy associated with persistent localized pain and diarrhea/constipation without evidence of inflammation at the blood examination [7].

Recurrent, uncomplicated diverticulitis was defined as the combination of multiple episodes of left lower quadrant abdominal pain, fever, leukocytosis, and evidence of inflammation on CT [5, 6].

Complicated diverticular disease was defined as pericolic abscesses, colonic perforation, diverticular bleeding, colonic diverticular stenosis, or colonic fistula [8].

All patients were operated by four colorectal surgeons with more than 10-year experience.

Mandatory technical steps that were reported in all surgical procedures were:

- Distal resection at the level of the upper rectum (the distal sigmoid was completely removed).
- Creation of an end-to-end double-staple Knight-Griffen anastomosis.
- Splenic flexure mobilization was not performed routinely during sigmoidectomy.
- Vascular ligation was performed proximal or distal to the left colic artery take-off.
- During sigmoidectomy, the level of the colonic transection was at the colonic-sigmoid junction.
- During left hemicolectomy, the distal descending colon was removed after splenic flexure mobilization.

Postoperative recurrent diverticulitis was defined as left-sided or lower abdominal pain, with CT scan-confirmed findings of diverticulitis. This study was approved by the Institutional Review Board of the medical center. All patients were enrolled in the Diverticular Disease Registry (DDR Trial) ClinicalTrials.gov (NCT04907383) [9].

Statistical analysis

Categorical variables were reported as frequencies (percentages), while continuous variables were reported as median (interquartile range) or mean ± standard deviation, as appropriate. The χ^2 test was used for categorical variables, and the Student *t* tests were used for continuous variables comparing patients with and without recurrence. Cox regression was used to perform a multivariate analysis of the variables found significant at the univariate analysis. The hazard ratios with 95% confidence interval were presented. Statistical significance was set at a p value of < 0.05. All statistical analyses were performed using the statistical software Statistical Package for the Social Sciences (SPSS) software (version 22, SPSS, Chicago, IL, USA).

Results

The patient's characteristics are listed in Table 1. One hundred ninety-eight patients (198/232; 85%) had 3 or fewer episodes of diverticulitis, and 79% (184/232) had a preoperative diagnosis of uncomplicated diverticular disease. One hundred forty-six patients (62.8%) had a history of diverticular disease longer than 5 years. Nineteen patients (8.2%) had a preoperative diagnosis of irritable bowel syndrome (IBS); 87.9% (204/232) of patients had diverticulitis of the sigmoid colon, while in 12.1% (28/232), the disease was involving the descending colon. 85.3% (198/232) of patients underwent sigmoidectomy, while 14.7% (34/232)

Table 1 Demographics

Participants	232
Male	129
Female	103
BMI	26.9 (± 2.3)
Age	51 (22–87)
ASA I	75
ASA II	84
ASA III	72
ASA IV	13
SUDD	61
SDD	54
Recurrence uncomplicated DD	69
Complicated DD	48

ASA American Society of Anesthesiologists, *BMI* body mass index, *SUDD* symptomatic uncomplicated diverticular disease, *SDD* smoldering diverticular disease, *DD* diverticular disease

underwent left hemicolectomy. 86.2% of patients (200/232) underwent a total laparoscopic procedure, conversion was recorded in 12/232 patients (5.2%) due to intraoperative bleeding (5 patients) and massive adhesions (7 patients), and open procedures were 20/232 (8.6%) for anesthesiologic contraindication to pneumoperitoneum. During surgery, 65.5% of patients (152/232) had the inferior mesenteric artery (IMA) ligated and 34.5% (80/232) preserved. After 30 days postoperatively, no mortality occurred; anastomotic leak was recorder in 4 patients (1.7%) requiring reintervention, anastomotic bleeding in 14 patients (6%) that required endoscopic hemostasis in cases, and only hemotransfusion in 6 cases; and postoperative ileus in 13 patients treated conservatively (5.6%) (Table 2).

In our prospective cohort, 20/232 (8.6%) patients developed CT-proven recurrent diverticulitis after elective surgery. The mean time to recurrence was 31 months (range, 4–86 months). Ten recurrences (50%) occurred within the first 3 years (4 in the first year, 3 in the second year, and 3 in the third one). All the 20 recurrent diverticulitis were uncomplicated and did not need surgery. Eighty-five percent (17/20) of the recurrences occurred in patients with a preoperative diagnosis of uncomplicated DD, 70% (14/20) in patients who had at least 4 episodes of diverticulitis preoperatively, and 70% (14/20) in patients with a history of diverticulitis extended to the descending colon.

A comparison was made between patients with recurrence and those without recurrence (Table 3). Univariate

Table 2 Results for each variable

Variable	Number	Percent
Female	103	44.4
Male	129	55.6
Age	51 (22–87)	
ASA I, II	181	78
ASA III, IV	51	22
No. of episodes of diverticulitis		
1	61	26.3
2	74	31.9
3	63	27.1
4	16	6.9
> 4	18	7.6
Diverticulitis of the sigmoid colon	204	87.9
Diverticulitis of the sigmoid and of the descending colon	28	12.1
Uncomplicated DD	184	79.3
SUDD	61	26.3
Smoldering DD	54	23.7
Recurrence uncomplicated DD	69	29.7
Complicated DD	48	20.7
Sigmoidectomy	198	85.3
Hemicolectomy	34	14.7
Laparoscopic	200	86.2
Open	32	13.8
IMA ligation	152	65.5
IMA preservation	80	34.5
Postoperative complications		
Anastomotic leak	4	1.7
Bleeding	14	6
Ileus	13	5.6
Length of the specimen		
< 20 cm	179	77.1
> 20 cm	53	22.8
Time from symptoms onset		
< 5 years	146	62.9
> 5 years	86	37.1
Smoker	52	22.4
Non-smoker	180	77.6
BMI > 30	25	10.7
BMI < 30	207	89.2
Presence of IBS	19	8.2
Absence of IBS	213	91.8
IgE in the specimen		
Yes	53	22.8
No	179	77.2

ASA American Society of Anesthesiologists, *BMI* body mass index, *SUDD* symptomatic uncomplicated diverticular disease, *SDD* smoldering diverticular disease, *DD* diverticular disease, *IMA* inferior mesenteric artery

Table 3 Univariate analysis in patients with recurrent disease and those without

Risk factor	Recurrence	Percent	No recurrence	Percent	*p* value
	20	8.6	212	91.4	
Female	11	55	92	43.4	0.82
Male	9	45	120	56.6	0.74
Age	55.1		50.3		0.69
ASA I, II	13	65	168	79.2	0.73
ASA III, IV	7	35	44	20.8	0.86
No. of episodes of diverticulitis					
1	1	5	60	28.3	0.06
2	2	10	72	34	
3	3	15	60	28.3	
4	7	35	9	4.2	
> 4	7	35	11	5.1	
Diverticulitis of the sigmoid colon	6	30	198	93.4	0.08
Diverticulitis of the sigmoid and of the descending colon	14	70	14	6.6	0.04
Uncomplicated DD	17	85	167	78.8	0.92
SUDD	5	25	56	26.4	0.94
Smoldering DD	7	35	47	22.2	0.06
Recurrence uncomplicated DD	5	25	64	30.2	0.82
Complicated DD	3	15	45	21.2	0.56
Sigmoidectomy	16	80	182	85.8	0.64
Hemicolectomy	4	20	30	14.2	0.71
Laparoscopic	17	85	183	86.3	0.97
Open	3	15	29	13.7	0.7
IMA ligation	12	60	140	66	0.96
IMA preservation	8	40	72	34	0.88
Length of the specimen					
< 20 cm	14	70	165	77.8	0.52
> 20 cm	6	30	47	22.2	0.62
Time from symptoms onset					
< 5 years	5	15	141	66.5	0.062
> 5 years	15	75	71	33.5	0.031
Postoperative complication CD > 3	2	10	16	7.5	0.12
Smoker	10	50	42	19.8	0.07
Non-smoker	10	50	170	80.2	0.06
BMI > 30	1	5	24	11.3	0.65
BMI < 30	19	95	188	88.7	0.93
Presence of IBS	8	40	11	5.2	0.04
Absence of IBS	12	60	201	94.8	0.09
IgE in the specimen					
Yes	9	45	44	20.7	0.06
No	11	55	168	79.3	0.09

ASA American Society of Anesthesiologists, *BMI* body mass index, *SUDD* symptomatic uncomplicated diverticular disease, *SDD* smoldering diverticular disease, *DD* diverticular disease, *IMA* inferior mesenteric artery, *CD* Clavien-Dindo complication rate

analysis showed that recurrence of diverticulitis after elective surgery was associated with diverticulitis of the sigmoid and of the descending colon ($p = 0.04$), with a preoperative diagnosis of IBS ($p = 0.04$), and with a longer than 5-year diverticular disease ($p = 0.03$). Cox regression analysis was not able to determine risks factors for recurrence (Table 4). Postoperative complications higher than Clavien-Dindo 3 rate did not affect the recurrence rate.

Table 4 Factors affecting recurrence

Factors	HR	(C.I. 95%)	*p* value
Diverticulitis of the sigmoid and of the descending colon	1.10	(0.54 to 2.21)	0.456
Onset of symptoms > 5 years	2.18	(0.91 to 4.62)	0.092
IBS presence	2.11	(1.00 to 3.39)	0.072

IBS irritable bowel syndrome

Discussion

Our study shows that recurrent diverticulitis is not a rare event since it was reported in almost 9% of the patients undergoing a colectomy. A preoperative diagnosis of IBS, diverticulitis involving del descending colon, and a long-lasting disease could be associated with recurrent diverticulitis.

Elective surgery is always carried out based on a shared decision between the surgeon and the patient, especially when treating a benign disease such as diverticulitis [10]. Consequently, a clinical recurrence could be considered as a treatment failure. The possibility that diverticulitis may recur must be carefully studied in order to be as comprehensive as possible at the time of explaining the outcomes of surgery to patients [11]. However, there is still few data about the incidence of recurrent diverticulitis. Indeed, literature reports the recurrence rate of patients operated for diverticulitis usually incorporating both urgent and elective procedures, thus becoming too heterogeneous [12]. Instead, there is a need to focus more on clinical outcomes following the elective procedures only. In this setting, the patient can be studied with more accuracy, and surgery can be planned accordingly.

A recent meta-analysis including 1062 patients reported the mean incidence of recurrence after surgery for diverticular disease of 5.8% (with a range between 3.5 and 8.7%) and identified IBS, uncomplicated recurrent diverticulitis, the anastomotic high, and age as associated factors for diverticulitis recurrence [4]. The data we report confirms that the presence of IBS and the chronicity of diverticular disease are associated with increased recurrent diverticulitis rates. Conversely, we did not find a significant association with patients' age. However, it is possible that the sample size or the follow-up of this study was not sufficient to detect this association.

In patients with preoperative IBS, elective surgery has the role of preventing future complicated episodes. Similarly to Choi et al. [5], it is our practice to propose surgery in patients with IBS only after a CT confirmed diagnosis of acute diverticulitis. However, the possibility of recurrent diverticulitis and mostly the persistence of intestinal symptoms must be fully and clearly explained to the patient in the moment of the acquisition of the informed consent [13].

Recurrent diverticulitis occurred more frequently in patients suffering from an active disease for more than 5 years. It is conceivable that other colonic segments may become more susceptible to inflammation with the persistence of the inflammatory state correlated with diverticulitis [14]. Low-grade inflammation, sensory motor nerve damage, and dysbiosis in fact could be involved in colonic tissues as a result of continuous and chronic inflammatory stimulation [15, 16].

Surely, performing a colo-sigmoid anastomosis after sigmoidectomy means leaving the colo-rectal junction in place. A colonic resection not extended to the upper rectum is known to be associated with increased rates of recurrent diverticulitis on the sigmoid remnant [17]. Indeed, Thaler et al. reported four times higher risk of recurrent diverticulitis in patients with colo-sigmoid anastomosis [18]. All the procedures we report were performed with the excision of the colo-rectal junction as a mandatory surgical step.

Differently from other reported series, we found that patients in whom diverticular disease also involves the descending colon could have higher rates of recurrence. Indeed, when the descending colon was involved by diverticulitis, it has to be removed to avoid recurrence at that level [19]. An inaccurate preoperative diagnosis could be the cause of the relapse in these patients. Indeed, the presence of diverticulitis in colonic segments other than the sigmoid colon can essentially be documented by an abdominal CT scan performed during an acute attack. In case of an acute attack not investigated with a CT scan could cause an underestimation of the real extension of the disease [20].

The finding that only 8.6% of patients developed recurrent diverticular disease, none of which requiring reoperation is somehow comforting. Based on this, we believe that offering elective surgical resection to patients for active diverticular disease should be after all maintained. According to the same findings, extending the surgical resection to the descending colon, if not a site of severe diverticulosis, should also not be routinary performed.

As highlighted, the preoperative diagnostic analysis plays a central role in the correct surgical indication in patients suffering from diverticular disease. Therefore, an inaccurate preoperative work-up could be at the basis of the disease recurrence. However, the difficulty in finding associations strong enough to become risk factors suggests that, to a certain extent up to now, we do not have a definitive explanation for DD recurrence after elective surgery. Surely, the different clinical presentations for which patients are given the indication for elective surgery can generate a heterogeneity in the analyzed population such as to introduce factors related to the development of recurrences that, ultimately, we do not fully understand yet.

Conclusion

The rate of recurrent diverticulitis after elective sigmoid resection was 8.6% which is similar to previously reported studies. Our study showed that patients with a preoperative diagnosis of IBS, diverticulitis involving descending colon and a long-lasting disease is more likely to have recurrent diverticulitis. However, these variables could not be assumed as real risk factors in this study. Multicenter diverticular disease registries and longer follow-up may provide new evidences to guide patient selection for elective diverticular disease surgery and define who could benefit from surgery the most.

Author contribution Mari G. and Montroni I. conceived the study; Santambrogio G. wrote the manuscript; Costanzi A., Maggioni D., and Laporta A. collected the data; and Calini G. performed the statistical analysis. All authors read and approved the final version of the manuscript.

Data availability All patients were enrolled in the Diverticular Disease Registry (DDR Trial) ClinicalTrials.gov (NCT04907383).

Declarations

Ethics approval This study was approved by the Institutional Review Board of the medical center.

Consent to participate All patients were enrolled in the Diverticular Disease Registry (DDR Trial) ClinicalTrials.gov (NCT04907383).

Consent for publication All patients were enrolled in the Diverticular Disease Registry (DDR Trial) ClinicalTrials.gov (NCT04907383).

Conflict of interest The authors declare no competing interests.

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