

## Original Paper

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# Severity of Diverticulitis Does Not Influence Abdominal Complaints during Long-Term Follow-Up

Max Ditzel<sup>b, d</sup> Sandra Vennix<sup>b</sup> Anand G. Menon<sup>c</sup> Paul C.M. Verbeek<sup>a</sup>  
Willem A. Bemelman<sup>b</sup> Johan F. Lange<sup>c, d</sup>

<sup>a</sup>Department of Surgery, Flevohospital Almere, Almere, The Netherlands; <sup>b</sup>Department of Surgery, Academic Medical Center, Amsterdam, The Netherlands; <sup>c</sup>Department of Surgery, Erasmus Medical Center, Havenziekenhuis, Rotterdam, The Netherlands; <sup>d</sup>Department of Surgery, Erasmus Medical Center, Rotterdam, The Netherlands

## Keywords

Diverticulitis · Long-term follow-up · Chronic abdominal pain · Abdominal adhesions

## Abstract

**Background:** Diverticulitis can lead to localized or generalized peritonitis and consequently induce abdominal adhesion formation. If adhesions would lead to abdominal complaints, it might be expected that these would be more prominent after operation for perforated diverticulitis with peritonitis than after elective sigmoid resection. **Aims:** The primary outcome of the study was the incidence of abdominal complaints in the long-term after acute and elective surgery for diverticulitis. **Methods:** During the period 2003 through 2009, 269 patients were operated for diverticular disease. Two hundred eight of them were invited to fill out a questionnaire composed of the gastrointestinal quality of life index and additional questions and finally 109 were suitable for analysis with a mean follow-up of 7.5 years. **Results:** Analysis did not reveal any significant differences in the incidence of abdominal complaints or other parameters. **Conclusion:** This retrospective study on patients after operation for diverticulitis shows that in the long term, the severity of

the abdominal complaints is influenced neither by the stage of the disease nor by the fact of whether it was performed in an acute or elective setting.

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## Introduction

The role of intra-abdominal adhesions with regard to symptoms remains unclear [1–4]. As the diagnosis of infertility and ileus caused by adhesions is well established, especially pain and other chronic complaints can be related to adhesions less obviously. Diverticular disease is a common condition that has been a cause of increased hospital admission in recent years [5]. Although in 75% of the cases non-surgical management will be sufficient, in about one quarter, surgery should be considered. Elective surgery can be performed in cases of recurrent disease, stenosis, fistula formation, and the suggestion of malignancy, while acute operative management can be indicated due to local or generalized peritonitis (Hinchey III and IV) [6, 7]. Especially the latter might induce abdominal adhesion formation possibly resulting in small-bowel obstruction, difficulties at reoperation, and infer-

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Max Ditzel, MD  
Department of Surgery, Academic Medical Center  
Diezestraat 8-II  
NL-1078 JP Amsterdam (The Netherlands)  
E-Mail M\_ditzel@hotmail.com

**Table 1.** Calculation of the score: most desirable option: 4. Points least desirable option: 0. Points GIQLI digestion sub-scale score: sum of the points

GIQLI questionnaire, questions digestion sub-scale score	
questions	answer
During the past 2 weeks, how often have you had pain in the abdomen?	0. All of the time
During the past 2 weeks, how often have you had a feeling of fullness in the upper abdomen?	1. Most of the time
During the past 2 weeks, how often have you had bloating (sensation of too much gas in the abdomen)?	2. Some of the time
During the past 2 weeks, how often have you been troubled by excessive passage of gas through the anus?	3. Rarely
During the past 2 weeks, how often have you been troubled by strong burping or belching?	4. Never
During the past 2 weeks, how often have you been troubled by gurgling noises from the abdomen?	
During the past 2 weeks, how often have you been troubled by fluid or food coming up into your mouth (regurgitation)?	
During the past 2 weeks, how often have you felt uncomfortable because of your slow speed of eating?	
During the past 2 weeks, how often have you been troubled by constipation?	
During the past 2 weeks, how often have you been troubled by heartburn?	

tility [8, 9]. Abdominal adhesions are also considered to be associated with chronic abdominal pain, although this remains widely under debate [1, 3, 10]. Provided that adhesions can induce chronic abdominal pain, one might expect more complaints after operation for diverticulitis with generalized peritonitis.

Recently it was shown that severe recurrence after successful nonoperative management of acute diverticulitis was low, and emergency surgery was rare [7, 11]. However, for those cases where operation is inevitable, the evidence is sparse concerning long-term effects. The aim of this study was to compare the severity of abdominal complaints following acute versus elective surgery for diverticular disease with a follow-up of 7.5 years.

## Methods

This study is a retrospective analysis of all patients undergoing operation for diverticulitis from 2003 through 2010 in 2 academic hospitals (Erasmus Medical Center Rotterdam and Academic Medical Center Amsterdam) and 2 affiliated community hospitals (Flevohospital in Almere and Havenziekenhuis Rotterdam). Patients were identified using the hospital administration code for diverticulitis with surgical therapy. They were excluded from analyses if postoperative pathology reports showed malignancy instead of diverticulitis. The study design was analogous to an earlier follow-up report of our research group [2]. Data on demography, clinical presentation, histopathology, operative reports, long-term outcomes, and postoperative complications were reviewed. In those cases where medical files were incomplete, the patients were excluded. In 2014, all patients were invited to fill out a questionnaire by regular mail. All survival data and addresses were checked at the municipal offices and nonresponders (NR) were contacted again after 6 weeks.

The need for ethical review was waived by the Ethical Committees of the participating hospitals, as it is not required for this type of study in the Netherlands. Informed consent was obtained from all patients who completed the questionnaire.

### Definitions

All patients were asked to confirm whether they experienced abdominal complaints during the previous 6 months. These complaints were further specified using the validated gastrointestinal quality of life index (GIQLI) questionnaire. The severity of diverticulitis was assessed according to the Hinchey classification [12] and based on the timing of the surgery. Acute surgery was defined as an operation within 24 h after admission. Laparoscopy included all laparoscopic procedures, including hand-assisted procedures. Conversion to open surgery was for the long-term results considered as open surgery. Postoperative bowel obstruction was defined as passage problems requiring placement of a nasogastric tube.

### Questionnaire

The questionnaire was divided into 2 parts: part 1 consisted of general questions about re-interventions and abdominal complaints: part 2 consisted of the GIQLI, an established tool for assessing the quality of life concerning different gastro-intestinal diseases [13]. This questionnaire can be divided into 4 subscales measuring different aspects of the quality of life – physical well-being, mental well-being, digestion, and defecation as described by Nieveen Van Dijkum et al. [14]. Gastrointestinal symptoms are reflected by the digestion sub-score consisting of questions about pain and fullness in the abdomen, bloating, flatus, burping, abdominal noises, regurgitation, eating speed, constipation, and heartburn (Table 1). These symptoms are of most interest and therefore the digestion sub-scale was used for further analysis.

### Outcomes of the Study

The primary outcome of the study was the incidence of abdominal complaints on the long-term effects after acute and elective surgery for diverticulitis. In addition, different Hinchey classification patterns, the influence of the operation technique (open vs. laparoscopic), presence of a (temporary) stoma, incisional hernia, reoperation, or small-bowel obstruction were investigated.

### Statistical Analysis

Categorical variables were represented as a number (percentage). Continuous variables were presented as mean (SD). Categorical variables were compared with the chi-square test, in the case of a count expected less than 5, a Fisher exact test was used; continuous variables were compared with the Student *t* test. In those cases where more than 3 groups with continuous variables were compared, the one-way analysis of variance test was used. All analyses were conducted using SPSS version 22.0.0 (SPSS Inc., Chicago, IL, USA). A *p* value <0.05 (2-sided) was considered statistically significant.

## Results

During the period 2003 through 2009, 269 patients were operated for diverticular disease. Of this group, 61 (22.7%) persons were excluded as they passed away (47), emigrated (2), or no correct contact records (12) were available. Therefore, 208 questionnaires were sent. Finally, 109 (52.4%) of them (28 after acute operation, 81 after elective operation) were suitable for complete analysis as shown in Figure 1. Mean follow-up time from initial operation was 7.5 years and did not significantly vary between responders (R) and NR (R 7.3 years vs. NR 7.7 years, *p* = 0.112). The R group was comparable with the NR group in terms of age, gender, operation technique, location of the diverticulitis, postoperative small-bowel obstruction and abscesses, timing of operation, Hinchey classification, and the number of reoperations (Table 2).

When asked about abdominal complaints during the previous 6 months, 48 patients mentioned no complaints at all, 37 were affected only during a small portion of the time, and 24 patients were afflicted by abdominal pain most or all of the time. Hinchey classification or timing of operation was not a risk factor, but this was further analyzed using the GIQLI. This analysis did not reveal any significant differences of the digestion subscale score for gender, operation technique, Hinchey classification, timing of operation, creation of a (temporary) stoma, reoperation, or bowel obstruction within 30 days as shown in Table 3. During follow-up, no significant differences were seen in hospital readmissions for abdominal complaints (A 32% vs. E 31%, *p* = 0.808), incisional hernia (A 32% vs. E 20%, *p* = 0.189), or small-bowel obstruction (A 11% vs. E 5%, *p* = 0.306; Table 4).

In the total study population, patients with Hinchey III or IV were mostly operated in the acute setting (70 out of 74). In total, 16 patients (3 with Hinchey I or II vs. 13 with Hinchey III or IV) died within 30 days after the initial

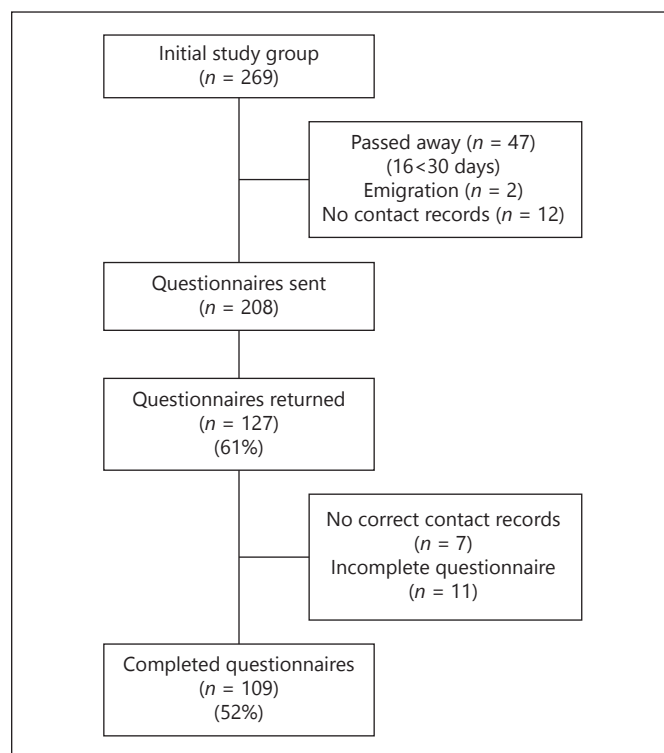


Fig. 1. Study profile.

operation. At the time of follow-up, 47 (mean age 71.1) patients had passed away and 39 (mean age 72.6 years) of them were urgently operated upon. In the R group, an open technique was significantly used more in the acute setting and these patients were significantly diagnosed more with Hinchey type III or IV (Table 5).

In the whole study population, 49 (18%) patients were reoperated one or more times within 30 days of initial operation because of bleeding (4), anastomotic leakage (11), wound dehiscence (6), open abdomen treatment (3), deep wound infection (3), rinsing of the abdomen (8), replacing ileostomy (2), small-bowel obstruction (2), or for other reasons (10). Baseline characteristics are described in Table 2.

In the R group, an end-colostomy was created in 9 patients, a protective ileostomy in 32, and a terminal ileostomy in 8 patients. At the end of follow-up, the bowel continuity was restored in 33 out of 43 patients (77%). No significant differences in the digestive subscale were found between the 43 patients with or the 66 without a stoma (Table 3). Additional analysis of the 33 patients in which the bowel continuity was restored did not reveal any differences as well (restored 32.5 vs. others 31.6; *p* = 0.576).

**Table 2.** *p* value concerns differences between R and NR. Analysis of NR and R excludes 47 deceased patients

	Baseline characteristics of total study population			<i>p</i> value
	total study population ( <i>n</i> = 269), <i>n</i> (%)	NR ( <i>n</i> = 113), <i>n</i> (%)	R ( <i>n</i> = 109), <i>n</i> (%)	
Age at operation	60.3	58.1	57.8	0.652
Follow-up, years, mean (SD)	7.5 (2.4)	7.7 (2.5)	7.3 (2.5)	0.112
Passed away	47 (18)	N/A	N/A	N/A
Female	158 (59)	63 (56)	63 (58)	0.758
Laparoscopically operated	69 (26)	33 (29)	36 (33)	0.538
Acute	96 (36)	29 (26)	28 (26)	0.997
Hinchey 3/4	74 (28)	21 (19)	22 (20)	0.763
Type				
Hartmann	53 (20)	16 (14)	9 (8)	0.211
Resection with anastomosis	192 (71)	87 (77)	89 (82)	
Others	24 (9)	10 (9)	11 (10)	
1 ≤ reoperations <30 days	49 (18)	18 (16)	13 (12)	0.346
Located in sigmoid	249 (93)	108 (96)	95 (88)	
Postoperative bowel obstruction <30 days	35 (13)	11 (10)	15 (14)	0.376
Postoperative abscess	25 (9)	13 (12)	5 (5)	0.054

N/A, not applicable.

**Table 3.** GIQLI, digestion sub-scale score. A higher score equals good outcome

	GIQLI questionnaire, results digestion sub-scale score		<i>p</i> value
	<i>n</i> = 109	mean digestive subscore	
Gender			0.385
Male	46	32.5	
Female	63	31.5	
Technique			0.078
Laparoscopic	36	30.1	
Open/converted	73	32.8	
Timing			0.931
Elective	81	32.0	
Acute	28	31.6	
Hinchey			0.642
1–2	87	31.7	
3–4	21	32.9	
Technique			0.962
Hartmann	9	31.8	
Resection with anastomosis	89	32.3	
Others	11	32.4	
1 ≤ reoperations <30 days			0.173
Yes	13	29.5	
No	96	32.3	
Postoperative bowel obstruction <30 days			0.575
Yes	15	32.5	
No	94	31.8	
Stoma			0.443
Yes	43	32.7	
No	66	31.4	

## Discussion

This retrospective study on the long-term complications after acute and elective operation in case of diverticulitis shows that the severity of the abdominal complaints is influenced neither by the stage of the disease nor by the fact of whether it was performed in an acute or elective setting.

Postsurgical abdominal adhesions contribute to an increased risk of small-bowel obstruction, difficulties at the time of reoperation, and infertility in women [15–17]. Every abdominal operation can induce adhesion formation, although in general it has been shown that laparotomy results in more adhesion formation than laparoscopy [18–21]. Another cause for the formation of adhesions is the presence of localized or generalized peritonitis [22, 23]. In this respect, it has been shown that after perforated appendicitis, the incidence of adhesion-related small-bowel obstruction significantly increases compared to that of non-perforated appendicitis [24, 25].

Abdominal adhesions are also associated with chronic abdominal pain; nevertheless, this relation has been subject of discussion for decades. It has been suggested that traction of adhesions on the peritoneum and viscera, nerve fibers in adhesions itself, or changes in the nervous system might contribute to chronic abdominal pain caused by adhesions when other organic

**Table 4.** Events during follow-up. *p* value concerns differences between A and E operated patients in the R group

	Events during follow-up			<i>p</i> value
	R ( <i>n</i> = 109), <i>n</i> (%)	A ( <i>n</i> = 28), <i>n</i> (%)	E ( <i>n</i> = 81), <i>n</i> (%)	
Readmission for abdominal complaints	34 (31)	9 (32)	25 (31)	0.808
Small-bowel obstruction nonoperative	7 (6)	3 (11)	4 (5)	0.306
Small-bowel obstruction operative	5 (5)	1 (4)	4 (5)	0.837
Other abdominal operations	29 (27)	9 (32)	20 (25)	0.529
Operation for incisional hernia	25 (23)	9 (32)	16 (20)	0.189

**Table 5.** Baseline characteristics. *p* value concerns differences between A and E operated patients in the R group

	Baseline characteristics; A vs. E			<i>p</i> value
	R ( <i>n</i> = 109), <i>n</i> (%)	A ( <i>n</i> = 28), <i>n</i> (%)	E ( <i>n</i> = 81), <i>n</i> (%)	
Age at operation	57.8	57.7	57.8	0.965
Follow-up, years, mean (SD)	7.3 (2.5)	7.5 (2.2)	7.2 (2.5)	0.594
Female	63 (58)	17 (61)	46 (57)	0.717
Open/converted	73 (67)	28 (100)	45 (56)	<0.001
Hinchey 3/4	22 (20)	20 (71)	2 (3)	<0.001
Type				
Hartmann	9 (8)	7 (25)	2 (3)	<0.001
Resection with anastomosis	89 (82)	15 (54)	74 (91)	
Others	11 (10)	6 (21)	5 (6)	
1 ≤ reoperations <30 days	13 (12)	4 (14)	9 (11)	0.655
Located in sigmoid	95 (88)	23 (85)	72 (89)	0.609
Postoperative bowel obstruction <30 days	15 (14)	5 (18)	10 (12)	0.466
Postoperative abscess	5 (5)	2 (7)	3 (4)	0.462

and functional diseases are excluded [1, 4]. However, other studies and this data do not support that relationship [2, 3].

Provided that abdominal adhesions can cause chronic abdominal pain, one might expect more complaints after open surgery and/or operation for Hinchey types III and IV. In this study, almost all operations in the acute setting were performed using the open technique (95 out of 96) and when patients were diagnosed with Hinchey classification III or IV, they were directly operated on (70 out of 74). Therefore, we hypothesized that patients operated in the acute setting might have more abdominal complaints after long-term follow-up. However, neither the timing of the operation nor the Hinchey classification proved to be a risk factor for abdominal complaints in the long term. Additionally, no significant differences were seen in terms of gender, operation technique, reoperation rate within 30 days, or the presence

of a (temporary) stoma. It is also possible that the impact of other abdominal operations during follow-up influenced our data. However, the number of operations did not significantly differ between the 2 groups suggesting that a potential effect of these operations was the same in both groups (Table 4).

Although the Hansen-Stock classification might have been more appropriate to apply, in the hospitals that were involved in this study, the Hinchey classification for severity of diverticulitis was used, as it is still generally applied in most studies [26–29]. Even more promising seems to be CT in combination with clinical parameters as recently stated by Bolkenstein et al. [26].

Despite the fact that this study did not find any differences between the 2 groups concerning abdominal complaints, a significant number of patients suffered from them. One can only hypothesize about the cause of

these complaints. In recent years, an evident correlation between the development of IBS and one or more episodes of diverticulitis has been shown, in conservatively as well as in operatively treated patients [30–32]. The exact pathophysiological mechanism still remains unclear, but one hypothesis includes a strong correlation between the inflammatory reaction induced by diverticulitis and the development of IBS, analogous to the postinflammatory model of postinflammatory-IBS [30, 33]. Since all patients in the present study were diagnosed with diverticular disease, the number of patients possibly with IBS should be randomly divided between the different groups and therefore not interfere with our results.

To the knowledge of the authors, the long-term effect on chronic abdominal complaints of acute versus elective surgery for diverticular disease has never been investigated. In recent years, it has become increasingly evident that individual patient factors are of significant importance when deciding whether colonic resection for diverticular disease should be performed or not. Different authors have shown that in carefully selected patients, elective surgery improves the quality of life compared to conservative therapy, although obviously the risk of complications should always be considered [34–36]. Recent results of the direct-direct trial confirm this, showing that elective sigmoidectomy, despite its inherent risk of complications, results in better quality of life than conservative management in patients with recurrent and persisting abdominal complaints after an episode of diverticulitis [28].

If elective surgery is indicated, guidelines agree that laparoscopic surgery is preferred in experienced hands because of lower morbidity and faster recovery [37, 38]. In those cases where acute surgery is inevitable, evidence for a safe laparoscopic approach is weak, and similar to our study, an open approach is most commonly undertaken [37]. In the last decade, laparoscopic peritoneal lavage has been investigated as an alternative to sigmoidectomy in patients with purulent peritonitis owing to perforated diverticulitis. However, recent randomized trials demonstrated that peritoneal lavage is not superior to sigmoidectomy [27, 29]. As our study period ended in 2010, just before increasing the popularity of laparoscopic lavage in the Netherlands, no lavage was performed in our study. However, forthcoming data of 2 more trials on perforated diverticulitis might eventually change the way perforated diverticulitis will be treated [39–41]. It should be interesting to see what the effect will be on chronic abdominal com-

plaints after long-term follow-up of laparoscopic lavage.

In the present study, 109 (52%) questionnaires were suitable for complete analysis. This is equivalent to other retrospective quality-of-life studies reporting follow-up percentages between 37 and 52% after 2.5 to 7 years of follow-up [2, 42–44]. Baseline characteristics did not significantly differ between R and NR suggesting that the R group reflects the whole study population. However, comparable to all retrospective studies, our data should be interpreted carefully because of selection bias. Additionally, the limited power of 28 R in the acute group should be taken into account. As mentioned above, 83% (39 out of 47) of the deceased patients were operated in the acute setting, relatively reducing the availability of patients for follow-up in this group. We can only speculate about the reason for the difference between the R/NR and total study population, but it is well known that age and general condition are important factors determining a successful outcome of surgery. The mean age of the deceased patients operated in the acute setting was 72.6 years. This is significantly older than the R/NR group (Table 2) and therefore a reasonable explanation for the larger number of deceased patients.

The treatment of diverticulitis continues to evolve toward an approach that is more conservative and minimally invasive [45]. However, when acute surgery is inevitable, collected data enable surgeons to inform patients that in the long run the amount of chronic abdominal complaints after acute operation will be comparable to patients who were electively operated on. Finally, as the presence of peritonitis in this study did not significantly relate to the occurrence of chronic abdominal complaints, it is concluded that adhesions play a minor role with regard to abdominal symptoms in the long term.

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## Disclosure Statements

The authors declare that they have no conflicts of interest to disclose.

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