International Journal of Colorectal Disease (2018) 33:513–523
https://doi.org/10.1007/s00384-018-3005-y

ORIGINAL ARTICLE

Quality of life after laparoscopic sigmoid resection for uncomplicated diverticular disease

Lino Polese[1,2] · Alice Bressan[1] · Edoardo Savarino[1] · Massimo Vecchiato[3] · Angelo Turoldo[4] · Annachiara Frigo[5] · Giacomo Carlo Sturniolo[1] · Nicolò De Manzini[4] · Roberto Petri[3] · Stefano Merigliano[1]

Accepted: 1 March 2018 / Published online: 10 March 2018

Abstract

Purpose The study aimed to evaluate the QoL in patients who underwent elective surgery for uncomplicated diverticulitis using a recently developed diverticulitis quality of life questionnaire (DV-QoL).

Methods All consecutive patients who underwent surgery for uncomplicated diverticulitis or who were hospitalized and treated conservatively for acute uncomplicated diverticulitis episodes in three referral centers, in a 5-year period, were included in the study. The 36-Item Short Form Survey and the DV-QoL were administered to the patients to assess their QoL before and after treatment of diverticular disease.

Results Ninety-seven patients who underwent surgery, 44 patients who were treated conservatively, and 44 healthy volunteers were included in the study. DV-QoL scores correlated with SF-36 scores ($p < 0.0001$). The surgically treated patients reported a worse quality of life before treatment with respect to the patients treated conservatively (mean 21.12 surgical vs 15.41 conservative, $p = 0.0048$). The surgically treated patients presented better post-treatment global scores with respect to the conservatively treated patients (mean: 6.90 surgical vs 10.61 conservative, $p = 0.0186$). Covariance analysis confirmed that the differences between the pre- and post-treatment DV-QoL scores were significantly higher in the surgical ($p = 0.0002$) with respect to the non-surgical patients. As far as single items were concerned, differences between the two groups were found in the pre- and post-treatment "concerns" and "behavioral changes" DV-QoL items.

Conclusions Sigmoidectomy reduces concerns about diverticulitis and behavioral changes due to the disease. Quality of life should be considered when referring patients with uncomplicated diverticulitis to surgery. Prospective studies are required to confirm this result.

Keywords Diverticulitis · Surgery · Quality of life · DV-QoL

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00384-018-3005-y) contains supplementary material, which is available to authorized users.

✉ Lino Polese
lino.polese@unipd.it

[1] Department of Surgery, Oncology and Gastroenterology, Padova University, Padova, Italy

[2] Clinica Chirurgica 3^, Policlinico Universitario, sesto piano. Via Giustiniani 2, 35128 Padova, Italy

[3] Department of General Surgery, University Hospital of Udine, Udine, Italy

[4] Department of Medical and Surgical Sciences, University of Trieste, Trieste, Italy

[5] Department of Cardiology, Chest and Vascular Surgery, University of Padova, Padova, Italy

Introduction

Colonic diverticulosis is a common, acquired condition characterized by the presence of mucosal and submucosal outpouchings at weak points in the muscularis propria where feeding blood vessels penetrate the muscle layer [1, 2]. Pseudodiverticula, which frequently occur in the sigmoid colon, vary in number and generally have a 5–10 mm diameter [3, 4]. Diverticular disease (DD) represents the fifth most important gastrointestinal (GI) disease in Western Countries in terms of direct and indirect healthcare costs with an estimated mortality rate of 2.5 per 100,000 per year [5]. The prevalence of diverticular disease increases substantially with age, and by the ninth decade, it affects almost 50% of the population [6–8]. DD is defined as diverticula associated with symptoms/complications, but not all patients suffering from DD

have symptoms, and, in fact, the Rome consensus defined "diverticulosis" as the presence of diverticula in the absence of symptoms [9]. The symptoms associated to complicated diverticular disease are as follows: abscess, phlegmon, perforation, fistula, obstruction, and/or bleeding.

Although complicated diverticulitis associated with peritonitis (Hincey Classification Stages III and IV), fistula or obstruction, is a clear indication for surgical treatment, the optimal management for uncomplicated diverticular disease remains to be established. Guidelines recommending treating patients surgically (i.e., elective sigmoid resection) after two attacks of acute diverticulitis have been recently reconsidered and judged inappropriate and lacking cost effectiveness [10]. It has been amply demonstrated, moreover, that elective resection for uncomplicated diverticulitis does not alter disease outcome, nor does it decrease mortality or complications [11, 12]. In fact, according to recent studies, it would take 18 elective procedures to prevent a single emergency operation. It is clear then that surgery in the case of uncomplicated diverticulitis (with the exception of immunocompromised or young patients) does not aim to prevent another acute attack, but simply to improve the patient's quality of life (QoL). According to recent guidelines, surgery, in fact, should be considered on a "case-by-case basis" also taking into consideration patients' quality of life [13]. Until now, however, no validated, standardized instrument for DD has been available to assess patients' well-being during the decision-making process. Spiegel and collaborators recently developed a new quality of life questionnaire, called the DV-QoL, that focuses on DD patients' perceptions of their disease-related physical and psychological symptoms [14].

The current study aimed to assess the DV-QoL questionnaire in patients who underwent sigmoid resection for uncomplicated DD or who were prescribed pharmacological treatment in three Italian centers and to validate its use in this setting. The questionnaire's relevance in managing this patient group was also assessed.

Methods

All the patients who underwent elective surgery in three Institutions (The Departments of Surgery and Gastroenterology University Hospitals in Padua, Trieste, and Udine) for uncomplicated diverticulitis during a 5-year period (2009–2014) were considered for inclusion in the study. All the patients considered for inclusion freely chose to undergo surgery because of symptoms compromising their quality of life. For comparison purposes, we also analyzed the data of consecutive patients admitted for diverticulitis during the same period who were treated conservatively (non-surgically) and a group of healthy volunteers.

In accordance with current practice, the diagnosis of diverticulitis was formulated on the basis of a clinical examination, blood tests, and radiological imaging findings. Study inclusion criteria included the following: left iliac fossa pain, leukocytosis, fever, radiological features of diverticulitis at CT scan; study exclusion criteria included the following: Hinchey III and IV [15], signs of fistula.

Information that was retrospectively collected from hospital records included the following: the type of diet the patient was following, smoking habits, alcohol consumption, bowel movements, number of previous attacks, disease extension, stenosis at bowel enema, CT scan or colonscopy findings, treatment with non-absorbable antibiotics (such as rifaximin), probiotics or mesalazine. Other information that was collected with regard to the surgical patients included the following: type of approach (laparoscopic or laparotomic), conversion to laparotomy, type of anastomosis (mechanical or manual), arterial section, early and late postoperative complications (anastomotic fistula, anastomotic stenosis, wound dehiscence, post-incisional hernia, urologic complications, other complications), days of hospitalization.

The surgically and non-surgically treated patients who satisfied the inclusion criteria were administered the DV-QoL and the 36-Item Short Form Survey (SF-36), a generic quality of life measure, by telephone twice: the first time (baseline), the patients were asked to respond to questions referring to their pre-treatment quality of life status; the second time, the patients were asked to respond to questions in view of their current (post-operative for surgical patients) condition.

The DV-QoL consists of four sections linked to four primary condition-related concepts (symptoms, concerns, emotions, behavioral changes); there are separate scores for each of these as well as a total score. The SF-36 consists of eight sections (physical functioning = PF, social functioning = SF, role limitation due to physical problems = RP, role limitation due to emotional problems = RE, mental health = MH, vitality (energy/fatigue) = VT, bodily pain = BP; there are separate scores for each of these as well as a total score.

Laparoscopic sigmoid resection: surgical technique

The procedure is normally performed as follows: after introducing a Hasson trocar using an open technique in the umbilical position, a pneumoperitoneum is created and the abdominal cavity is explored. Three other trocars are positioned: two in the right hypocondrium and the right iliac fossa and one in the subxifoid position. The colon is mobilized in a medial to lateral fashion, the Todt fascia is opened behind the inferior mesenteric vein, and the left ureter is recognized and preserved. Whenever possible, the inferior mesenteric artery is preserved, and a more peripheral vessel is sacrificed. If the inferior mesenteric artery must be sacrificed to manage the inflammatory mass, it is divided distal to the left colic artery.

The splenic flexure is mobilized and the rectum is resected below the recto-sigmoid junction. The sigmoid colon is exteriorized through a suprapubic incision, and a mechanical terminal-terminal circular anastomosis is performed. The integrity of the anastomosis is verified by air-leak test.

Statistical analysis

Pearson's correlations were used to compare the scores on the questionnaires of the two groups [14]. Student's t test was used to analyze the baseline and post-treatment scores. Covariance analysis (ANCOVA) was performed to compare the variation in the pre- and post-treatment scores on the two questionnaires. ANCOVA was also performed to evaluate the improvement in quality of life in the surgical and non-surgical patients as far as the presence or absence of colonic stenosis and/or two or more hospitalization for acute diverticulitis was concerned. A p value of < 0.05 was considered statistically significant.

Results

One hundred and fourteen operated patients were considered eligible for the study: 97 agreed to participate and responded to the questionnaires; 17 were considered ineligible for the following reasons: ten patients declined to participate, one could not respond due to Alzheimer disease, and six patients had complicated diverticulitis. Sixty non-operated patients were considered eligible for the study: 44 agreed to participate and responded to the questionnaires; 16 were considered ineligible for the following reasons: 13 patients declined to participate, one could not respond due to Alzheimer disease, and two of the patients had a selection bias (one was operated after discharge from another city; the other was hospitalized for colonic hemorrhage). The data of 97 operated and 44 non-operated patients were analyzed (Fig. 1). We also analyzed the data of 44 healthy volunteers who were age and sex matched with the non-operated patients to validate the Italian version of the DVQoL.

As shown in Table 1, the two groups of patients with diverticulitis were comparable for sex but not for age. No differences were found in the two groups with regard to the duration of symptomatic DD before hospitalization. The number of previous admissions for acute diverticulitis was comparable in the two groups. The surgical patients had a statistically higher frequency of stenosis (34.04 vs 9.37%) and of colonic stiffness (54.25 vs 17.24%) registered at imaging examinations with respect to their counterparts.

Operative and post-operative data about surgical population are shown in Table 2.

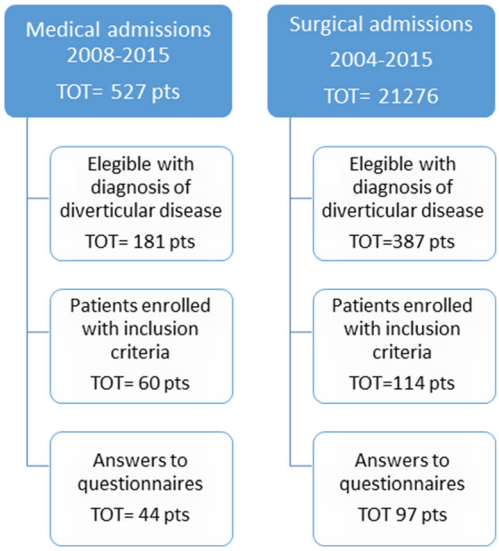

Fig. 1 Patient enrollment

All the patients treated conservatively (non-surgically) were prescribed intestinal antibiotics such as rifaximin at discharge.

Translation validation of the DV-QoL

The Italian version of the DV-QoL (Appendix 1) was drafted by an English-Italian "bilingual" translator who translated the original English DV-QoL [14] version into Italian; the questionnaire's backward translation into its original language format was carried out by another English-Italian "bilingual" translator and checked for inconsistencies with the original text. The patients' responses to the DV-QoL were compared with their responses to the Italian version of the SF-36, a generic quality of life measure, to verify if the new questionnaire showed adequate measurement properties. Pearson's correlation was used to analyze the statistical correlation between the two questionnaires (Table 3). The analysis uncovered a statistically significant correlation between the patients' scores on the two questionnaires. It also demonstrated that the DV-QoL scores were able to distinguish between the DD patients and the healthy volunteers utilized as controls. Indeed, the overall and subscale DV-QoL scores in the patients and healthy volunteers were statistically significantly different (Table 4).

Post-treatment quality of life

The surgically and non-sugically treated patients' DVQoL and SF-36 scores referring to their pre-hospitalization QoL are outlined, respectively, in Tables 5 and 6. The patients who underwent surgical treatment had worse overall, pre-treatment DV-QoL scores with respect to the non-surgically treated patients. In particular regarding the scores pertinent to

Table 1 The pre-treatment characteristics of the surgical and non-surgically treated patients

	Operated (97)	Not operated (44)	*P*
Sex	M 43 F 54	M 18 F 26	0.7
Mean age (ys)	61 ± 11	67 ± 14	0.006
Mean disease duration (ys)	4.4 ± 6	3.9 ± 8	0.87
< 2 admissions > 2 admissions	43/94 (46%) 51/94 (54%)	25/40 (62%) 15/40 (38%)	0.09
Stenosis			
Presence Absence	32/94 (34%) 5/34 (15%)	62/94 (66%) 29/34 (85%)	0.04
Stiffness			
Presence Absence	51/94 (54%) 43/94 (46%)	5/34 (15%) 29/34 (85%)	< 0.0001

each item, concerns and behavioral changes were worse in surgical population, before treatment. The total SF-36 scores were not significantly different in the two patient groups ($p = 0.1599$).

Post-treatment quality of life

The pre- and post-treatment scores on the DV-QoL and SF-36 of the surgical and non-surgical patients are outlined, respectively, in Tables 7 and 8. According to the global score and "concerns" and "behavioral changes" item scores on the DV-QoL, the surgical patients' post-treatment QoL was better than that of the non-surgical patients. Scores on the "symptoms" and "emotions" items were not significantly different in the two groups. Considering the SF-36, no differences were found in the two groups on the post-treatment "General Health" item but the surgical patients had higher scores on the "Vitality" item with respect to the non-surgically treated patients.

Pre- and post-treatment variations in QoL scores

The differences in the pre- and post-treatment DV-QoL scores analyzed using ANCOVA were more marked in the surgical group (Table 9 and Fig. 2). Considering (Fig. 3), patients with worse basal QoL (in abscissa) presented a higher QoL improvement after surgery with respect to medical treatment.

There were also statistically significant differences in the "physical functioning," "Role limitations due to physical problems," "vitality," "Mental Health," and "social functioning" SF-36 items. In short, the surgical patients had lower (worse) pre-treatment and higher (better) post-treatment scores with respect to the non-surgical patients on those items confirming that they perceived greater improvement on those SF-36 subscales. The variations in the global pre- and post-treatment SF-36 scores in the two groups were not statistically different (Table 10).

Comparison of patients with and without risk factors

The DV-QoL and SF-36 were also used to assess the QoL of the surgically treated patients with regard to the presence or absence of colonic stenosis and/or two or more previous attacks. The analysis was carried out to examine if the patients with colonic stenosis and/or two or more previous attacks (the old guidelines for surgery in cases of uncomplicated diverticulitis) who underwent the surgical procedure show greater QoL improvement with respect to the patients without those

Table 2 Operative and post-operative data of surgical population. *IMA* inferior mesenteric artery

Operative data	*n*/total	%	Complications	*n*/total	%
Laparoscopy	86/97	88.7	Early complications		
Conversion	3/86	3.5	SSI	9/97	9.3
Laparotomy	11/97	11.3	Anastomotic leak	1/97	1
Mechanical anastomosis	91/97	93.8	Hemorrhage	4/97	4.1
Hand-sewn anastomosis	6/97	6.2	Late complications		
IMA ligation	77/97	79.4	Anastomotic stenosis	6/97	6.2
Sigmoid arteries ligation	20/97	20.6	Post-incisional hernia	4/97	4.1
Days of hospitalization	8.21 ± 5.59	(mean ± SD)	Constipation	8/97	8.2

Table 3 Pearson's correlation between items on the SF-36 and DV-QoL

Pearson correlation coefficients, $N = 136$ Prob > |r| under H0: Rho = 0					
	Symptoms	Concerns	Emotions	Behavioral changes	Total
PF	− 0.23780	− 0.15758	− 0.27107	− 0.33122	− 0.32245
	0.0053	0.0669	0.0014	< 0.0001	*0.0001*
RP	− 0.45871	− 0.20517	− 0.43953	− 0.53799	− 0.53743
	< 0.0001	0.0166	< 0.0001	< 0.0001	*< 0.0001*
RE	− 0.29407	− 0.11948	− 0.27037	− 0.34645	− 0.33868
	0.0005	0.1659	0.0015	< 0.0001	*< 0.0001*
VT	− 0.30968	− 0.18369	− 0.31776	− 0.37552	− 0.38483
	0.0002	0.0323	0.0002	< 0.0001	*< 0.0001*
MH	− 0.37036	− 0.31432	− 0.44248	− 0.41986	− 0.49250
	< 0.0001	0.0002	< 0.0001	< 0.0001	*< 0.0001*
SF	− 0.34769	− 0.30873	− 0.38937	− 0.47873	− 0.48778
	< 0.0001	0.0003	< 0.0001	< 0.0001	*< 0.0001*
BP	− 0.47155	− 0.38586	− 0.53773	− 0.46298	− 0.59111
	< 0.0001	< 0.0001	< 0.0001	< 0.0001	*< 0.0001*
GH	− 0.32411	− 0.24864	− 0.45066	− 0.34694	− 0.43530
	0.0001	0.0035	< 0.0001	< 0.0001	*< 0.0001*

Pearson's correlation was used to analyze the statistical correlation between the two questionnaires. The analysis uncovered a statistically significant correlation between the patients' scores on the two questionnaires

Abbreviations: *PF* physical functioning, *RP* role limitation due to Physical Problems,*RE* role limitation due to emotional problems,*VT* vitality (energy/fatigue), *MH* mental health, *SF* social functioning, *BP* bodily pain,*GH* general health

features (Table 11). No differences in QoL improvement in the two groups were found with regard to this variable.

Discussion and conclusion

Diverticular disease, which is characterized by uncomplicated and complicated forms, is defined by the presence of colonic diverticula with and without related symptoms/complications. While the indication for surgery is clear if the disease is complicated and there are signs of diffuse peritonitis (Hinchey classification 3 and 4), fistula, obstruction, and/or bleeding, it is unclear when the disease is uncomplicated.

Basing its recommendations on the description of clinical features found in the literature, in 2000, the American Society of Colon and Rectal Surgeons (ASCRS) proposed the following guidelines for elective surgery for diverticular disease: the presence of complications such as strictures or fistulas, two episodes of Hinchey type 1-II diverticulitis; one episode in young patients [16]. The rationale underlying those indications was the high risk of recurrence (33%) after every episode and of perforation as well as high rates of morbidity and mortality. It is also important to remember that the risk of a diverting stoma is much higher during emergency (56%) with respect to elective resections (15%) [17].

Several studies published after the year 2000 reported better prognosis in patients with recurrent diverticulitis. In a study

Table 4 Comparison of partial and total DV-QoL scores in the patient vs healthy volunteer groups

DVQoL item	Patients mean/std D	Healty volunteers mean/std D	P ($\alpha = 0.05$)
Symptoms	7.368/4.275	2.409/2.635	*< 0.0001*
Concerns	3.028/3.125	0.113/0.386	*< 0.0001*
Emotions	3.780/3.470	0.340/1.584	*< 0.0001*
Behavioral changes	5.163/4.071	0.5/1.691	*< 0.0001*
Total DVQoL score	19.340/11.247	3.363/5.081	*< 0.0001*

Table 5 Comparison of partial and total pre-treatment DV-QoL scores in the surgical vs the non-surgical groups

DV-QoL item	Surgical treatment mean/std D	Medical treatment mean/std D	P ($\alpha = 0.05$)
Symptoms	7.7526/4.4769	6.5227/3.7010	0.1138
Concerns	3.5155/2.9584	1.9545/3.2490	*0.0056*
Emotions	4.1340/3.3060	3/3.7292	0.0721
Behavioral changes	5.7216/4.0537	3.9318/3.8784	*0.0151*
Total DV-QoL score	21.1237/11.1311	15.4091/10.5947	*0.0048*

by Chapman et al. who analyzed 337 patients hospitalized for complicated diverticulitis, 90% of the patients who died had no history of diverticulitis [18]. A long-term study on 25,058 patients admitted to the Seattle Hospital for diverticulitis found that 80.3% were treated conservatively; 19% of these had a second diverticulitis attack, but only 5.5% required subsequent, urgent surgery. Given these findings, several surgeons have changed their approach to the diverticular disease. Surgeons from Denmark and Scandinavia, for example, have abandoned recommendations for routine sigmoid resection following two episodes of diverticulitis and, instead, reserve elective sigmoid resection for patients with frequent recurrence of diverticulitis and for those with complications such as stenosis, fistulas, or persisting abscesses [19, 20]. According to recent German guidelines, patients with chronic uncomplicated diverticulitis (type 3b) should undergo surgery only after a careful risk/benefit assessment based on persistent/chronic symptoms during the disease-free interval (individual medical decision) has been made, and the general rule of elective interval surgery depending on the number of inflammatory episodes is no longer upheld [21]. Similarly in 2006, the American Society of Colon and Rectal Surgeons (ASCRS) changed its indications for elective surgery for uncomplicated diverticular disease; the number of attacks was no longer considered an indication for surgery. Instead the society recommended that the decision be made on a "case by case" basis [22] and underlined the importance of considering the disease's impact on the patient's quality of life when a surgical approach was being contemplated [23–27].

Given the nature and course of DD, it would be important to accurately evaluate QoL in these patients in order to select the best candidates for surgery. A specific questionnaire explicitly examining patients' disease-related health condition would be a valuable instrument in this context. The DV-QoL is a relatively new instrument that was specifically developed to help physicians gauge patients' gastrointestinal/QoL condition. While the SF-36 is a generic survey of patient health, the DV-QoL specifically examines physical and psychological aspects related to diverticular disease. A strict correlation between DV-QoL and SF-36 items was demonstrated in a study by Spiegel et al. [14] and was also confirmed by of the findings of the current study which aimed to validate the Italian version of the questionnaire.

The current study also aimed to utilize the DV-QoL to evaluate the quality of life of patients suffering from uncomplicated chronic symptomatic diverticular disease and to compare the results in surgically and non-surgically treated patients. Although the surgically treated patients had worse pre-treatment scores, they had better post-treatment global scores and scores on the "concerns" and "behavioral changes" items, a picture reflecting fewer disease-related preoccupations and a new behavioral approach. The surgically treated

Table 6 Pre-treatment SF-36 subscale scores

SF-36 item	Surgical treatment mean/std D	Medical treatment mean/std D	P ($\alpha = 0.05$)
PF	84.7807/17.2319	81.15/23.9674	0.4147
SF	67.3158/24.1455	70.1/29.5913	0.6119
RP	59.7368/41.8055	51.25/37.9566	0.3095
RE	69.9538/37.3354	49.5/37.5212	*0.0094*
MH	60.3860/20.6170	59.40/21.5999	0.8206
VT	58.1930/21.1343	56.2750/27.9092	0.7010
BP	47.4474/28.8637	61.4750/41.4364	0.0690
GH	62.6842/22.3919	56.4550/19.4988	0.1599

Abbreviations: *PF* physical functioning, *RP* role limitation due to physical problems, *RE* role limitation due to emotional problems, *VT* vitality (energy/fatigue), *MH* mental health, *SF* social functioning, *BP* bodily pain, *GH* general health

Table 7 Post-treatment DV-QoL partial and total scores

DV-QoL item	Surgical treatment mean/std D	Medical treatment mean/std D	P ($\alpha = 0.05$)
Symptoms	4.0515/3.7399	3.5227/3.1585	0.4165
Concerns	0.4330/0.9003	2.5682/2.8806	*< 0.0001*
Emotions	0.8969/1.7882	1.7955/2.7835	0.0540
Behavioral changes	1.5155/2.1656	2.7273/3.5264	*0.0395*
Total DV-QoL score	6.8969/6.9589	10.6136/9.0790	*0.0186*

patients stated, in fact, "that they were no longer concerned about diverticular disease" because "the diseased part of the colon had been removed." In addition, they were no longer concerned about the worsening of symptoms, nor were they fearful about new diverticulitis attacks. Finally, the patients pointed out they "no longer needed a special diet or a continuous therapy to prevent symptoms."

A statistically significant difference was not found in the "physical symptoms" item of the DV-QoL in the two patient groups, a result that is consistent with the findings of Senapati A. who reported that surgery did not seem to improve pain in diverticular disease [28]. In fact, physical symptoms such as painful constipation, abdominal distension, and cramps could be due to the persistence of irritable bowel syndrome (IBS) already present before surgery or to ongoing non-systemic inflammation or postoperative adhesions, as was described by Egger et al. [29]. It is nevertheless important to remember that medical therapy could improve symptoms and prevent recurring attacks [30–32]. Although the absence of greater improvement in the "physical symptoms" item in the surgically treated patients is surprising, given the high frequency of stenosis (34.04%) and stiffness (54.25%) at radiologic imaging in these patients, it concurs with the finding that post-treatment variations in QoL were not significantly different as far as the presence or absence of stenosis was concerned. It could also be argued that if radiologic imaging is necessary for decision-making in patients with chronic diverticular disease, the Dv-QoL could provide some additional information regarding the disease's impact on the patient's QoL. As far as the SF-36 is concerned and in agreement with Scarpa M. et al.'s study [33], the patients' overall general health scores were not significantly different in the two groups after treatment. Differences in the two questionnaires could in any case be explained by the fact that the SF-36 is not a specific questionnaire focusing on symptomatic uncomplicated diverticular disease (SUDD), but simply a standard instrument to investigate patients' perceived general health.

It is important to point out that at the post-treatment assessment, some patients mentioned other new pathologies that were not present previously. Since the SF-36 is a generic instrument, it might not be able to discriminate between different pathologies and to gauge their impact on quality of life, despite the fact that we excluded patients with Alzheimer, a disease that could alter the patient's perception of quality of life. Study results showed that improvement in quality of life was greater in the surgical with respect to the non-surgically treated patients, and the difference was more marked in the patients with worse pre-treatment quality of life (Fig. 3).

Table 8 Post-treatment SF-36 subscale scores

SF-36 item	Surgical treatment mean/std D	Medical treatment mean/std D	P ($\alpha = 0.05$)
PF	86.6667/19.3033	76.5/28.1753	0.0521
SF	83.2982/20.5291	76.4875/28.0769	0.1952
RP	78.5088/34.2126	65.6250/39.5031	0.0901
RE	86.6690/27.8497	75.6500/34.1207	0.0839
MH	69.3509/20.6713	61.9500/21.8725	0.0934
VT	65.0877/21.0546	54.1250/28.6609	*0.0432*
BP	78.9947/25.6664	76.8250/32.2799	0.7135
GH	66.2982/22.8965	59.5750/21.9310	0.1508

No differences were found in the two groups on the post-treatment "general health" item but the surgical patients had higher scores on the "vitality" item with respect to the non-surgically treated patients

Abbreviations: *PF* physical functioning, *RP* role limitation due to physical problems, *RE* role limitation due to emotional problems, *VT* vitality (energy/fatigue), *MH* mental health, *SF* social functioning, *BP* bodily pain, *GH* general health

Table 9 ANCOVA analysis of pre- and post-treatment variations in partial and total DV-QoL scores

DV-QoL item	Mean variation post-pre	95% confidence limits	Difference between means (95% confidence limits)	*P*
Symptoms				
Medical	− 3.548	− 4.59/− 2.506	− 0.139	0.7465
Surgical	− 3.409	− 4.095/− 2.722	(− 1.387/1.108)	
Concerns				
Medical	− 0.14	− 0.668/0.387	2.503	*< 0.0001*
Surgical	− 2.644	− 2.9858/− 2.302	(1.875–3.132)	
Emotions				
Medical	− 1.805	− 2.437/− 1.174	1.125	*0.0048*
Surgical	− 2.931	− 3.35/− 2.513	(0.368–1.883)	
Behavioral changes				
Medical	− 1.887	− 2.644/− 1.129	1.864	0.4367
Surgical	− 3.751	− 4.242/− 3.261	(0.962–2.766)	
DV-QoL total				
Medical	− 7.308	− 9.587/− 5.029	5.517	*0.0002*
Surgical	− 12.826	− 14.281/− 11.370	(2.813–8.221)	

As far as the guidelines which recommend a tailored surgical approach for uncomplicated diverticulitis is concerned [24–27], we are convinced that quality of life should indeed represent an important decision-making element in view of the fact that, as demonstrated by our study, improvement in quality of life is an independent factor as far as colonic stenosis and/or number of previous attacks of acute diverticulitis is concerned.

The current study has several weaknesses: first of all, the questionnaires regarding the patient's pre-treatment status were administered retrospectively; this may have created confusion between the two periods for some of the participants. Second, the two groups were not homogeneous: the non-surgical patients were older and this too could have created a study bias. Moreover, when the patients were asked to respond to questions regarding their pre-treatment health, the mean

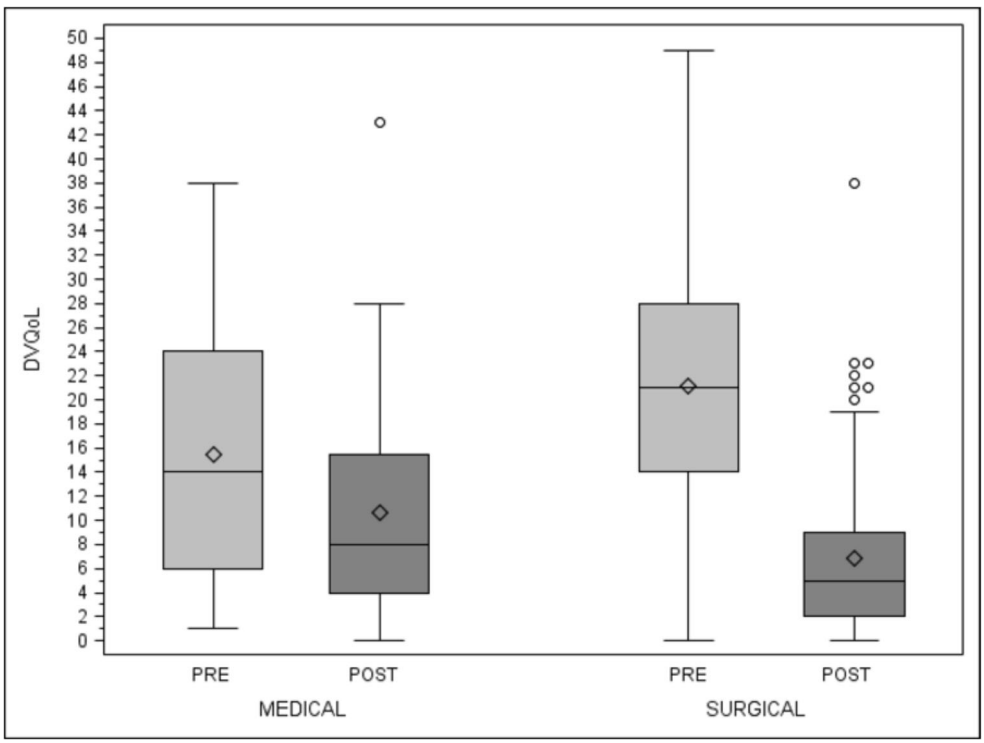

Fig. 2 Variation DV-QoL final-basal, comparison between medical and surgical patients

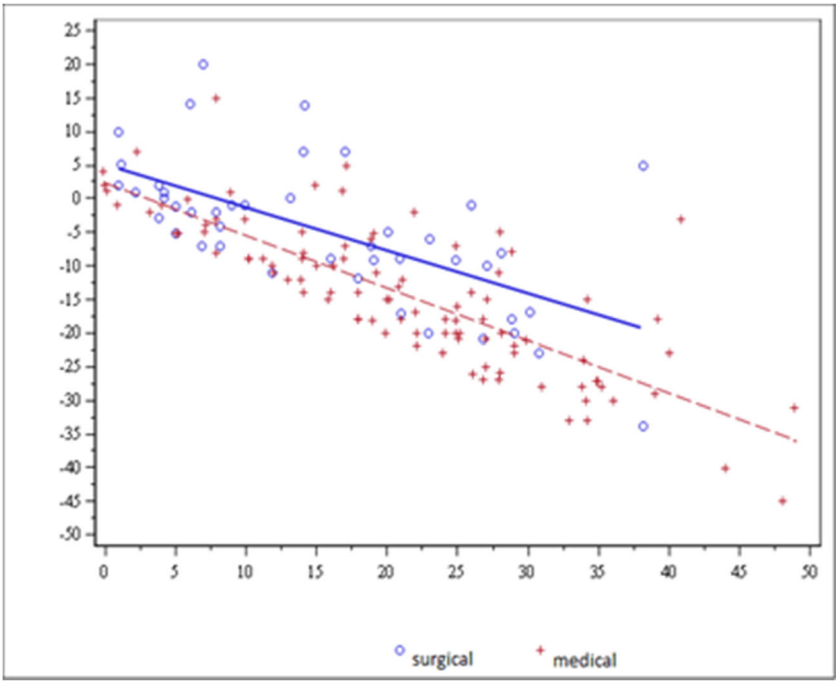

Fig. 3 Variation DV-QoL (in ordinate) final basal between medical and surgical patients. From this graphic, it results that patients with worse basal QoL (in abscissa) present a higher QoL improvement after surgical treatment (the two lines move away)

Table 10 ANCOVA analysis of pre- and post-treatment variations in subscale and total SF-36 scores

SF-36 item	Means variation post-pre	95% confidence limits	Difference between means (95% confidence limits)	*P*
PF				
Medical	− 4.552	− 9.712/0.606	− 7.364	*< 0.0001*
Surgical	2.811	− 1.509/7.132	(− 14.094/− 0.634)	
RP				
Medical	11.870	0.935/22.805	− 9.947	*0.014*
Surgical	21.818	12.705/30.931	(− 24.182/4.286)	
RE				
Medical	17.659	8.064/27.253	− 5.245	0.392
Surgical	22.904	15.063/30.746	(− 17.637/7.146)	
VT				
Medical	− 2.389	− 8.293/3.515	− 9.715	*0.0048*
Surgical	7.326	2.380/12.272	(17.417/− 2.012)	
MH				
Medical	2.475	− 2.78/7.731	− 6.758	*0.0004*
Surgical	9.233	4.831/13.635	(− 13.613/0.097)	
SF				
Medical	7.031	0.521/13.542	− 8.081	*0.0064*
Surgical	15.113	9.662/20.565	(− 16.573/0.409)	
BP				
Medical	20.92	12.284/29.555	− 6.281	0.2709
Surgical	27.20	19.966/34.436	(− 17.546/4.984)	
GH				
Medical	2.611	− 2.807/8.030	− 2.016	0.4971
Surgical	4.627	0.137/9.117	(− 9.053/5.021)	

Abbreviations: *PF* physical functioning, *RP* role limitation due to physical problems, *RE* role limitation due to emotional problems, *VT* vitality (energy/fatigue), *MH* mental health, *SF* social functioning, *BP* bodily pain, *GH* general health

Table 11 ANCOVA analysis of pre- and post-treatment variations in DV-QoL and SF-36 scores with regard to the presence or absence of stenosis and/or two or more previous attacks

DV-QoL SF-36 Stenosis and/or two or more attacks (Y-N)	Mean variation post-pre	95% confidence limits	Difference between means (95% confidence limits)	*P*
DV-QoL total				
Yes	− 14.218	− 17.023/− 11.412	− 2.821	0.3162
No	− 17.039	− 22.148/− 11.929	(− 8.650/3.007)	
GH (SF-36)				
Yes	2.276	− 3.263/7.816	− 1.340	0.4821
No	0.936	− 9.911/11.784	(− 13.521/10.840)	

DV-QoL scores were higher (worse) in the surgically treated patients and, in fact, those patients showed a significantly higher frequency of stenosis (34.04 vs 9.37%) and colonic stiffness (54.25 vs 17.24%) at imaging. This difference seems to confirm the appropriateness of the current guidelines recommending surgery for patients presenting colonic stricture [34]. It is noteworthy that the patients with radiologic signs of stenosis included in this study underwent surgery electively for chronic symptoms and not for acute obstruction. Moreover, the Hinchey classification was used as our enrollment criteria because it is simple and widely utilized in the surgical field to evaluate patients. It would have been more appropriate to use the classification proposed by the German guidelines [21] to differentiate the types of chronic diverticular disease. The surgically treated patients enrolled in our study presented uncomplicated chronic symptomatic diverticular disease. Nevertheless, some patients with radiological signs of stenosis but without clinical bowel obstruction were included. According to the German Guidelines, these patients could be better described by type 3 b diverticular disease, and type 3 c, limited to the patients with radiological stenosis, while patients with fistula or conglomerate tumors (also included in the type 3 c according to the German Classification) were excluded.

The non-surgical group was less numerous than the surgical one studied because patients with acute uncomplicated diverticulitis are, in accordance with the current guidelines, generally treated as outpatients [35], and this too could have created another study bias. Finally, both questionnaires were conceived for self-administration, instead they were phone-administered.

To conclude, study results demonstrated that the DV-QoL accurately captured the well-being and psychological state of the DD patients studied before and after treatment. The study also showed that laparoscopic sigmoid resection improves the quality of life in patients with uncomplicated diverticular disease independently of the presence of colonic stenosis or the number of previous acute diverticulitis attacks requiring hospitalization. The improvement in the patients' quality of life mainly regarded the psychological and behavioral fields, and in 95% of the cases studied, the patients expressed satisfaction with the improvement they experienced. The DV-QoL could be a useful complementary diagnostic instrument that could be used together with clinical and imaging findings to assess patients being considered for surgery. The decision to operate should, in fact, not only be tailored to the individual patient but also based on a multi-criteria analysis and on current guideline recommendations. Further perspective studies are, of course, warranted.

SSI surgical site infection

Acknowledgements The authors are grateful to Linda Inverso Moretti (native English speaker) for editing the English version of this manuscript

Compliance with ethical standards

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

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Slack WW (1962) The anatomy, pathology, and some clinical features of divericulitis of the colon. Br J Surg 50:185–190
2. Petruzziello L, Iacopini F, Bulajic M, Shah S, Costamagna G (2006) Review article: uncomplicated diverticular disease of the colon. Aliment Pharmacol Ther 23:1379–1391
3. Stollman N, Raskin JB (2004) Diverticular disease of the colon. Lancet 363:631–639
4. Custer TJ, Blevins DV, Vara TM (1999) Giant colonic diverticulum: a rare manifestation of a common disease. J Gastrointest Surg 3:543–548
5. Sandler RS, Everhart JE, Donowitz M, Adams E, Cronin K, Goodman C, Gemmen E, Shah S, Avdic A, Rubin R (2002) The

burden of selected digestive diseases in the United States. Gastroenterology 122:1500–1511
6. Painter NS, Burkitt DP (1975) Diverticular disease of the colon, a 20th century problem. Clin Gastroenterol 4:3–22
7. Schoetz DJ (1999) Diverticular disease of the colon: a century-old problem. Dis Colon Rectum 42:703–709
8. Parks TG (1975) Natural history of diverticular disease of the colon. Clin Gastroenterol 4:53–69
9. Tursi A, Picchio M, Elisei W, Di Mario F, Scarpignato C, Brandimarte G (2016) Management of patients with diverticulosis and diverticular disease: consensus statements from the 2nd international symposium on diverticular disease. J Clin Gastroenterol 50(Suppl 1):S101–S107
10. Regebongen SE, Hardiman KM, Hendren S, Morris AM. (2013) Surgery for diverticulitis in the 21 st century, a systematic review. JAMA surgery 2014 mar; 149 (3): 292-303 Clin Gastroenterol Hepatol 11:1532–1537
11. Wolff BG, Boostrom SY (2012) Prophilactic resection, uncomplicated diverticulitis, and recurrent diverticulitis. Dig Dis 30:108–113
12. Collins D, Winter DC (2008) Elective resection for diverticular disease: an evidence-based review. World J Surg 32:2429–2433
13. Peery AF, Sandler RS (2013) Diverticular disease: reconsidering conventional wisdom. Clin Gastroenterol Hepatol 11:1532–1537
14. Spiegel BM, Reid MW, Bolus R et al (2015) Development and validation of a disease-targeted quality of life instrument for chronic diverticular disease: the DV-QOL. Qual Life Res 24:163–179
15. Hinchey EJ, Schaal PG, Richards GK (1978) Treatment of perforated diverticular disease of the colon. Adv Surg 12:85–109
16. Wong WD, Wexner SD, Lowry A et al (2000) Practice parameters for the treatment of sigmoid diverticulitis—supporting documentation. The standards task force. The American Society of Colon and Rectal Surgeons. Dis Colon Rectum 43:290–297
17. Anaya DA, Flum DR (2005) Risk of emergency colectomy and colostomy in patients with diverticular disease. Arch Surg 140: 681–685
18. Chapman J, Davies M, Wolfe B et al (2005) Complicated diverticulitis. Is it time to rethink the rules? Ann Surg 242:576–581
19. Schultz JK, Yaqub S, Øresland T (2016) Management of diverticular disease in Scandinavia. J Clin Gastroenterol 50:S50–S52
20. Andersen JC, Bundgaard L, Elbrønd H, Laurberg S, Walker LR, Støvring J, Danish Surgical Society (2012) Danish national guidelines for treatment of diverticular disease. Dan Med J 59:C4453
21. Kruis W, Ngyen GP, Leifeld L (2016) German Guidelines. J Clin Gastroenterol 50:S47–S49
22. Rafferty J, Shellito P, Hyman NH, Buie WD (2006) Standards Committee of American Society of colon and rectal surgeons. Practice parameters for sigmoid diverticulitis. Dis Colon Rectum 49:939–944
23. Cuomo R, Barbara G, Pace F, Annese V, Bassotti G, Binda GA, Casetti T, Colecchia A, Festi D, Fiocca R, Laghi A, Maconi G, Nascimbeni R, Scarpignato C, Villanacci V, Annibale B (2014) Italian consensus conference for colonic diverticulosis and diverticular disease. United Eur Gastrenterol J 2:413–422
24. Binda GA, Cuomo R, Laghi A, Nascimbeni R, Serventi A, Bellini D, Gervaz P, Annibale B, Italian Society of Colon and Rectal Surgery (2015) Italian society of colon and rectal surgery. Practice parameters for the treatment of colonic diverticular disease: Italian society of colon rectal surgery (SICCR) guidelines. Tech Coloproctol 19:615–626
25. Andeweg CS, Mulder IM, Felt-Bersma RJ, et al. Netherlands Society of Surgery; working group from Netherlands societies of internal medicine, gastroenterologists, radiology, health technology assessment and dieticians. (2013) Guidelines of diagnostic and treatment of acute left-sided colonic diverticulitis. Dig Surg 30: 278–292
26. Feingold D, Steele SR, Lee S, Kaiser A, Boushey R, Buie WD, Rafferty JF (2014) Practice parameters for the treatment of sigmoid diverticulitis. Dis Colon rectum 57:284–294
27. Vennix S, Morton DG, Hahnloser D, Lange JF, Bemelman WA (2014) Research committee of the European society of coloproctocology. Systematic review of evidence and consensus on diverticulitis: an analysis of national and international guidelines. Color Dis 16:866–878
28. Senapati A (2012) The surgeon's view. Dig Dis 30(1):129–134
29. Egger B, Peter MK, Candinas D (2008) Persistent symptoms after elective sigmoid resection for diverticulitis. *Dis Colon rectum* 51: 1044–1048
30. Bianchi M, Festa V, Moretti A, Ciaco A, Mangone M, Tornatore V, Dezi A, Luchetti R, de Pascalis B, Papi C, Koch M (2011) Meta-analysis: longterm therapy with rifaximin in the management of uncomplicated diverticular disease. Aliment Pharmacol Ther 33: 902–910
31. Colecchia A, Vestito A, Pasqui F, Mazzella G, Roda E, Pistoia F, Brandimarte G, Festi D (2007) Efficacy of longterm administration of the poorly adsorbed antibiotic Rfaximin, in symptomatic, uncomplicated colonic diverticular disease. World J Gastroenterol (13):264–269
32. Tursi A, Brandimarte G, Elisei W, Picchio M, Forti G, Pianese G, Rodino S, D'Amico T, Sacca N, Portincasa P, Capezzuto E, Lattanzio R, Spadaccini A, Fiorella S, Polimeni F, Polimeni N, Stoppino V, Stoppino G, Giorgetti GM, Aiello F, Danese S (2013) Randomised clinical trial: mesalazine and/or probiotics in maintaining remission of symptomatic uncomplicated diverticular disease—a double-blind, randomised, placebo-controlled study. Aliment Pharmacol Ther 38:741–751
33. Scarpa M, Griggio L, Rampado S, Ruffolo C, Citton M, Pozza A, Borsetto L, Dall'Olmo L, Angriman I (2011) Long-term health–related quality of life after minimally invasive surgery for diverticular disease. Langenbeck's Arch Surg 396:833–843
34. Venara A, Toqué L, Barbieux J, Cesbron E, Ridereau-Zins C, Lermite E, Hamy A (2015) Sigmoid stricture associated with diverticular disease should be an indication for elective surgery with lymph node clear. J Visc Surg 152:211–215
35. Jackson JD, Hammond T (2014) Systematic review: outpatient management of acute uncomplicated diverticulitis. Int J Color Dis 29:775–781