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ORIGINAL ARTICLE

Dietary restrictions for acute diverticulitis: evidence-based or expert opinion?

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Abstract
Purpose Diet restrictions are usually advised as part of the conservative treatment for the acute phase of a diverticulitis episode. To date, the rationale behind diet restrictions has never been thoroughly studied. This study aims to investigate which factors influence the choice of dietary restriction at presentation. Additionally, the effect of dietary restrictions on hospitalization duration is investigated.
Methods All patients hospitalized for Hinchey 0, Ia, or Ib diverticulitis between January 2010 and June 2011 were included. Patients were categorized according to the diet imposed by the treating physician at presentation and included nil per os, clear liquid, liquid diet, and solid foods. The relation between Hinchey classification, C-reactive protein, leucocyte count and temperature at presentation and diet choice was examined. Subsequently, the relation between diet restriction and number of days hospitalized was studied.
Results Of the 256 patients included in the study 65 received nil per os, 89 clear liquid, 75 liquid diet, and 27 solid foods at presentation. Solely high temperature appeared to be related to a more restrictive diet choice at presentation. Patients who received liquid diet (HR 1.66 CI 1.19–2.33) or solid foods (HR 2.39 CI 1.52–3.78) were more likely to be discharged compared to patient who received clear liquid diet (HR 1.26 CI 1.52–3.78) or nils per os (reference group). This relation remained statistically significant after correction for disease severity, treatment and complications.
Conclusion Physicians appeared to prefer a more restrictive diet with increasing temperature at presentation. Notably, dietary restrictions prolong hospital stay.

Keywords Diverticulitis · Diverticular · Diet · Dietary

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Introduction

Diverticulitis is a common disease and leads to approximately 13,500 hospitalizations per year in the Netherlands [1]. Despite diverticulitis being one of the most frequent gastro-intestinal diseases, much remains unclear on the optimal treatment during admission.

The majority of patients present with a Hinchey 0, Ia, or Ib diverticulitis and can often be treated conservatively [2, 3]. Diet restrictions are usually advised as part of the conservative treatment. The European Association of Endoscopic surgery advises clear liquid diets for mild and nil per os (NPO) for moderate and severe cases of diverticulitis [4]. The American Society of Colon and Rectal Surgeons recommend a liquid diet for all patients with diverticulitis [5]. In a more recent article on the clinical management of diverticulitis, an easy digestible low-residue diet is advocated [2]. Notably, consensus between guidelines is lacking. The guidelines do agree on the lack of conclusive data supporting their diet recommendation.

The rationale behind diet restrictions for treating the acute phase of a diverticulitis episode has never been thoroughly studied. Many physicians recommend diet restrictions assuming that this may result in a less active bowel with a positive effect on the healing of the site of infection and ultimately shortening hospitalization time [4]. Furthermore, it is thought

that a more restricted diet is mandatory with increasing disease severity [2].

This study aims to determine whether these assumptions hold. To date the most objective instrument for determining disease severity in patients with diverticulitis is the Hinchey classification [3]. It is primarily hypothesized that the diet choice is based on the Hinchey classification in such a way that a higher classification leads to a more restricted diet. Secondarily, this study aimed to investigate the relation between dietary restrictions and hospital stay.

Methods

Study population

The hospital records were searched for all patients who were diagnosed with diverticulitis at the emergency unit using a diagnosis specific code for diverticulitis between January 2010 and June 2011. Patients were included in the study if they were hospitalized with initial conservative treatment for, and during the entire hospital stay were treated under, the diagnosis diverticulitis. All patients included had either a CT-scan or sonography at presentation to determine the modified Hinchey classification (Table 1) [3]. Patients with a Hinchey II at presentation were excluded.

Baseline characteristics

Data of all patients included in this study regarding patient characteristics, treatment and complications during hospital stay were collected from the hospital uptake and discharge forms. The American Society of Anesthesiologists (ASA) Physical Status classification was collected from the anesthesiologist report made within half a year before or after presentation. If these reports were not available, one of the researchers determined the ASA classification based on the medical history reported in the hospital uptake forms at presentation.

Baseline characteristics were described per diet.

Table 1 Modified Hinchey classification [3]

Modified Hinchey classification	
0	Mild clinical diverticulitis
Ia	Confined pericolic inflammation–phlegmon
Ib	Confined pericolic abscess (<5 cm)
II	Pelvic, distant intraabdominal, or retroperitoneal abscess
III	Generalized purulent peritonitis
IV	Fecal peritonitis

Study outcome

The outcome for the primary hypothesis of this study was the diet restriction imposed by the treating physician at presentation. In the Meander Medical Center, consensus among dieticians has led to four standardized and predefined grades of diet restrictions for treating diverticulitis patients. These diet restrictions have been in use prior to the study period and consist of NPO, clear liquid diet, liquid diet, and solid foods. NPO encompasses no intake whatsoever. Clear liquid diet consists of solely transparent liquids (e.g., water, apple juice or lemonade). A liquid diet comprises of foods with a liquid consistency, consequently avoiding the need to chew (e.g., custard and porridge). Solid foods include all nutrients with a solid consistency ranging from easy digestible foods (e.g., chicken, soft fruit or white bread) to a normal, unrestricted diet. Data regarding the diet restrictions imposed at presentation were extracted from the patient's nursing records. These records contain a standardized form in which nurses are obliged to prospectively list the diet restrictions as prescribed by the treating physician at the start of each day of all patients hospitalized. For baseline purposes, the mean number of successive diet regimes was calculated per diet restriction imposed at presentation.

The outcome for the secondary hypothesis was the number of days hospitalized. This was calculated from the hospital admission and discharge dates stored in the digital hospital records. The choice to discharge a patient from the hospital was left at the discretion of the treating physician.

Determinant and confounders

The primary outcome, diet restriction imposed at presentation, was related to disease severity as defined by the modified Hinchey classification and other parameters including temperature, C-reactive protein (CRP) and leucocyte count [6]. An independent researcher (RK) determined the Hinchey stadium based on the findings described in the digital radiological reports of CT-scans and/or sonographies made at presentation.

The heights of CRP and leucocyte count at presentation were extracted from the digital biochemistry records. Data on the temperature, as measured in all patients at presentation, was extracted from the digital emergency unit records.

The secondary outcome, number of days hospitalized, was related to the aforementioned diet restriction imposed at presentation. Potential confounders in this relation were assumed to be age, gender, and disease severity defined by the aforementioned Hinchey classification, biochemistry results, and temperature at presentation. Additionally, complications which are known to increase hospitalization duration (perforation, development of abscess) were included in the analysis. Antibiotic use was also considered to be a

confounder. Data regarding antibiotic use was extracted from the hospital discharge forms.

Statistical analysis

For describing baseline characteristics the mean of normally distributed and median of non-normally distributed variables were used. Distributions were described as either standard deviation or range between the 5th and 95th percentile. Normality was determined using histograms. Categorical variables were described as counts and percentages.

Only complete cases were used for analyzing the primary and secondary research question. All incomplete cases were compared to complete cases with regard to baseline characteristics, determinants, and outcome to exclude whether data was missing selectively.

For analyzing the relation between diet restriction and Hinchey classification, CRP (in milligrams per liter), leucocyte count ($n \times 10^{-9}$/l) and temperature (°Celsius) ordinal regression was used. Prior to the final analysis, the data was tested whether conditions for performing ordinal regression were met. This was done by constructing a cross-table with all categorical variables included in the final analysis and determining whether no cells contained zero counts and more than 80 % of cells had a count of five or higher. Furthermore, non-normal variables were log-normal transformed for the analysis. Both univariate and multivariate logit ordinal regression of complete cases was used to analyze the crude relation between determinants and diet restriction. The proportional odds assumption was tested using the test for parallel lines. The relation was described as proportional odds ratio's calculated by exponentiation of the beta coefficients obtained from the multivariate logit ordinal model. A p value under the 0.05 was considered significant.

Cox regression was used to analyze the relation between number of days hospitalized and the diet restriction imposed at presentation. Diet restriction and Hinchey classification were operationalized as categorical variables in the model. Non-normal continuous variables were log normally transformed. Univariate Cox regression was used to analyze the crude relation between number of days hospitalized and diet restriction. Correction for the aforementioned confounder was done using a multivariate Cox model. The results were described as hazard ratios (HR). A p value under the 0.05 was considered significant.

Results

Participants

A total of 290 consecutive patients were seen at the emergency unit with a clinical suspicion for diverticulitis between January 2010 and June 2011 (Fig. 1). Twelve patients were excluded as they were either not hospitalized or had a concomitant ileus at presentation.

Of the 278 hospitalized patients, 18 did not receive subsequent radiological examination and were therefore excluded. Four patients were additionally excluded because of the need for an acute resection on the day of presentation due to signs of perforated diverticulitis on radiological examination or presenting with Hinchey II diverticulitis. Finally, 256 patients were included.

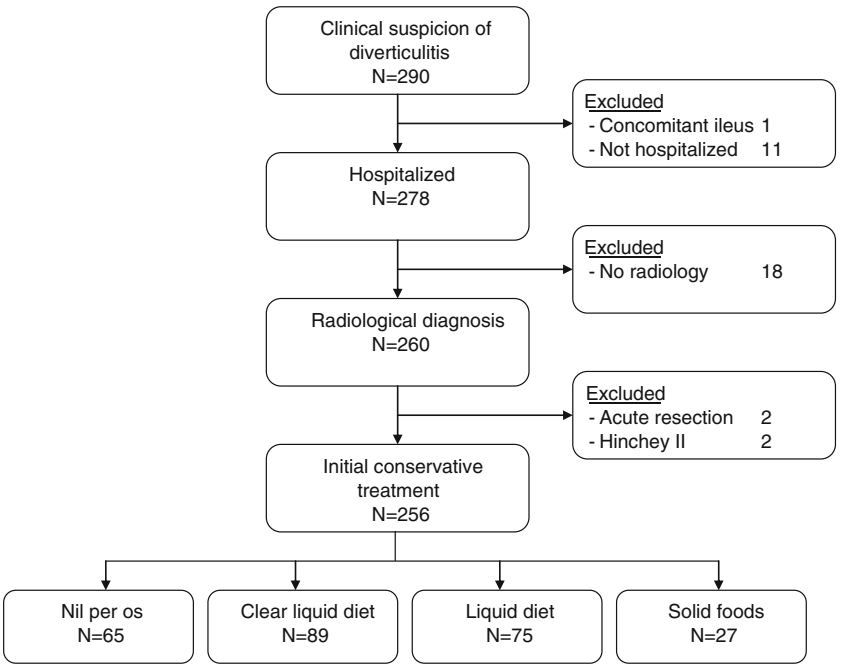

Fig. 1 Flowchart: selection of study population

Table 2 Baseline characteristics of the 256 patients included in the study

Patient characteristics		Nil per os *N*=65	Clear liquid diet *N*=89	Liquid diet *N*=75	Solid foods *N*=29
Gender	Male	30 (46.2 %)	37 (41.6 %)	28 (37.3 %)	15 (55.6 %)
Age (mean)	years	56.6 (13.1)	59.6 (12.3)	59.9 (14.7)	57.6 (14.8)
ASA	I	23 (35.4 %)	44 (49.4 %)	29 (38.7 %)	11 (40.7 %)
	II	36 (55.4 %)	34 (38.2 %)	41 (54.7 %)	15 (55.6 %)
	III	5 (7.7 %)	10 (11.2 %)	5 (6.7 %)	1 (3.7 %)
	IV	1 (1.5 %)	1 (1.1 %)	0 (0 %)	0 (0 %)
Physical/serologic examination					
Temperature (mean)	Celsius	37.7 (0.80)	37.5 (0.75)	37.4 (0.75)	37.3 (0.97)
CRP (mean)	mg/l	118 (92.7)	114 (92.6)	103 (93.3)	83 (74.1)
Leucocyte count(mean)	10^{-9}/l	12.9 (4.7)	12.5 (3.6)	11.9 (3.7)	11.9 (5.1)
Treatment					
Antibiotics		26 (40.6 %)	25 (28.1 %)	24 (32.0 %)	7 (25.9 %)
Days hospitalized (median)		5 (1–16)	4 (1–15)	3 (1–8)	3 (2–4)
Complications during hospitalization	Treated operatively	1 (1.5 %)	1 (1.1 %)	0 (0 %)	0 (0 %)
	Treated conservatively	1 (1.5 %)	2 (2.2 %)	1 (1.3 %)	0 (0 %)
Number of successive diet regimes during hospital stay (median)		3 (2–4)	3 (1–3)	2 (1–2)	1

Categorical variables are described in counts and (percentages). Continuous normally distributed variables are described as means with (standard deviation). Continuous non-normally distributed variables are described as medians with (range between 5th and 95.0 percentile)

Main study results

Overall baseline characteristics of this study population are enlisted per diet restriction in Table 2. The distribution of diet restriction according to the modified Hinchey classes is described in Table 3. Of the 256 patients included in the study, 65 received NPO, 89 clear liquid, 75 liquid diet, and 27 solid foods. Patients who were hospitalized with NPO received a median of three successive diet regimes (including the starting diet) before being discharged. This amounted to three for clear liquid, two for liquid and, logically, one for patient who were hospitalized with solid foods as diet.

For analysis of the relation between diet restriction imposed by the treating physician at presentation and Hinchey classification, CRP, leucocyte count and temperature, 10 patients (7 in NPO and 3 in clear liquid diet group) of the 256 patients were excluded because data on the temperature at presentation was not available. Analysis of these 10 incomplete cases showed no differences in baseline characteristics, determinants or outcome compared to complete cases.

Univariate analysis showed that patients with a Hinchey Ia diverticulitis episode tended to receive a less restrictive diet (OR 1.57 95 % CI 0.80–3.06) and patients with Hinchey Ib diverticulitis a more restrictive diet (OR 0.62 95 % CI 0.26–1.46) when compared to patients with Hinchey 0 diverticulitis. Furthermore, patients tended to receive a more restrictive diet with increasing titers for CRP (OR 0.92 CI 0.76–1.11), leucocyte count (OR 0.95 CI 0.90–0.99) and increasing temperature (OR 0.67 CI 0.51–0.90) at presentation. Only leucocyte count and temperature reached statistical significance (Table 4).

After multivariate analysis, solely body temperature remained significantly related to the diet choice with an odd's ratio of 0.72 (CI 0.53–0.98) indicating that patients with fever tend to receive a more restrictive diet.

For the analysis of the relation between number of days hospitalized and diet restriction imposed at presentation, ten patients were excluded for similar reasons as previously described. The median length of hospital stay for NPO, clear liquid, liquid diet and solid foods was 5 (1–16), 4 (1–15), 3 (1–8), and 3 (2–4), respectively. Univariate analysis confirmed that patients who received a less restrictive diet at hospitalization were more likely to be discharged (Table 5) (Fig. 2). Notably, this relation reached statistical significance

Table 3 Distribution of diet restriction according to Hinchey classification

	NPO	Clear liquid	Liquid	Solid foods	Total
Hinchey 0	11 (32.4 %)	12 (35.3 %)	6 (17.6 %)	5 (14.7 %)	34
Hinchey Ia	39 (21.1 %)	64 (34.6 %)	61 (33.0 %)	21 (11.4 %)	185
Hinchey Ib	15 (40.5 %)	13 (35.1 %)	8 (21.6 %)	1 (2.7 %)	37

Table 4 Results of univariate and multivariate analysis of relation between diet restriction imposed by the treating physician at presentation and Hinchey classification, CRP, leucocyte count, and body temperature

	Proportional odds ratio	95 % Confidence interval	*P* value
Univariate			
Hinchey 0[a]	0	–	–
Hinchey Ia	1.57	0.80–3.06	0.18
Hinchey Ib	0.62	0.26–1.46	0.27
CRP	0.92	0.76–1.11	0.36
Leucocyte	0.95	0.90–0.99	0.04
Temperature	0.67	0.51–0,90	0.008
Multivariate			
Hinchey 0[a]	1	–	–
Hinchey Ia	1.80	0.90–3.60	0.10
Hinchey Ib	0.76	0.30–1.93	0.56
CRP	1.00	0.99–1.01	0.79
Leucocyte	0.97	0.92–1.03	0.35
Temperature	0.72	0.53–0.98	0.03

[a] Reference group for categorical variables

in a patient who received a less restrictive diet than a clear liquid diet (HR 1.26 CI 0.91–1.73). Patients who were given a liquid diet had a 1.66 (CI .19–2.33) and patients who started with solid foods had a 2.39 higher likelihood (CI 1.52–3.78) to be discharged compared to patient who received NPO at hospitalization. This relation remained statistically significant after correction for age, gender, complications, antibiotic use, Hinchey classification and other parameters that are assumed to be related to disease severity (C-reactive protein, leucocyte count and temperature at presentation). The hazard ratios were 1.21 (CI 0.86–1.69) for clear liquid, 1.53 (CI 1.06–2.20) for liquid and 2.04 (CI 1.27–3.29) for solid foods, respectively.

Complications requiring operative management during hospitalization occurred in one (1.5 %) patient who received NPO and one (1.1 %) in the liquid diet group (Table 2).

Discussion

This retrospective study demonstrates that both nil per os, clear liquid, liquid diet, and solid foods are all prescribed for patients with an acute phase of a diverticulitis episode in daily practice. The diet choice does not seem to depend on the Hinchey classification, nor does it relate to the height of C-reactive protein or leucocyte count. Physicians, however, seem to advice a more restricted diet with increasing fever at presentation. Notably, advising a more restrictive diet at presentation and hospitalization for a diverticulitis episode decreases the probability to be discharged and therefore might lead to longer hospitalization duration. This relation does not change after correction for age, gender, complications, antibiotic use, Hinchey classification and several other factors that are assumed to be related to disease severity.

This is the first study to investigate diets in the acute phase of a diverticulitis episode. Essentially, this study demonstrates that consensus regarding the optimal diet for the acute phase of diverticulitis is lacking. As a result, potentially unnecessary restrictive measures with regard to the diet are taken that might lead to needlessly long hospitalizations.

It was an unexpected finding that the Hinchey classification was not related to diet choice. Moreover, patients with a Hinchey 0 received a more restricted diet compared to patients with Hinchey Ia. The fact that the diet choice does not depend on Hinchey classification, could imply that the choice is a more subjective matter based on old principles, personal preferences and the interpretation of symptoms. If the physician's choice of the diet is indeed a subjective issue, it may be questioned whether diet restrictions are even necessary. Ultimately, patients could be given the freedom to determine their diet according to their own needs without any restrictions in case of a Hinchey 0, Ia, or Ib diverticulitis.

Table 5 Results of univariate and multivariate analysis of relation between diet restriction imposed by the treating physician at presentation and number of days hospitalized

	Hazard ratio	95 % Confidence interval	*P* value
Univariate			
Nil per os[a]	1	–	–
Clear liquid diet	1.26	0.91–1.73	0.17
Liquid diet	1.66	1.19–2.33	0.003
Solid foods	2.39	1.52–3.78	0.0008
Multivariate			
Nil per os[a]	1	–	–
Clear liquid diet	1.21	0.86–1.69	0.28
Liquid diet	1.53	1.06–2.20	0.02
Solid foods	2.04	1.27–3.29	0.003
Age	0.994	0.987– 0.999	0.21
Gender (female)[a]	1	–	–
Gender (male)	1.45	1.10–1.90	0.007
Antibiotic (no)[a]	1	–	–
Antibiotic (yes)	0.86	0.64–1.16	0.33
CRP	0.91	0.80–1.03	0.13
Leucocyte	1.00	0.97–1.04	0.82
Temperature	0.89	0.75–1.07	0.20
Hinchey class 0[a]	1	–	0.58
Hinchey class Ia	0.95	0.63–1.42	0.80
Hinchey class Ib	0.78	0.46–1.32	0.36
Complication (no)[a]	1	–	–
Complications (yes)	0.23	0.09–0.59	0.002

[a] Reference group

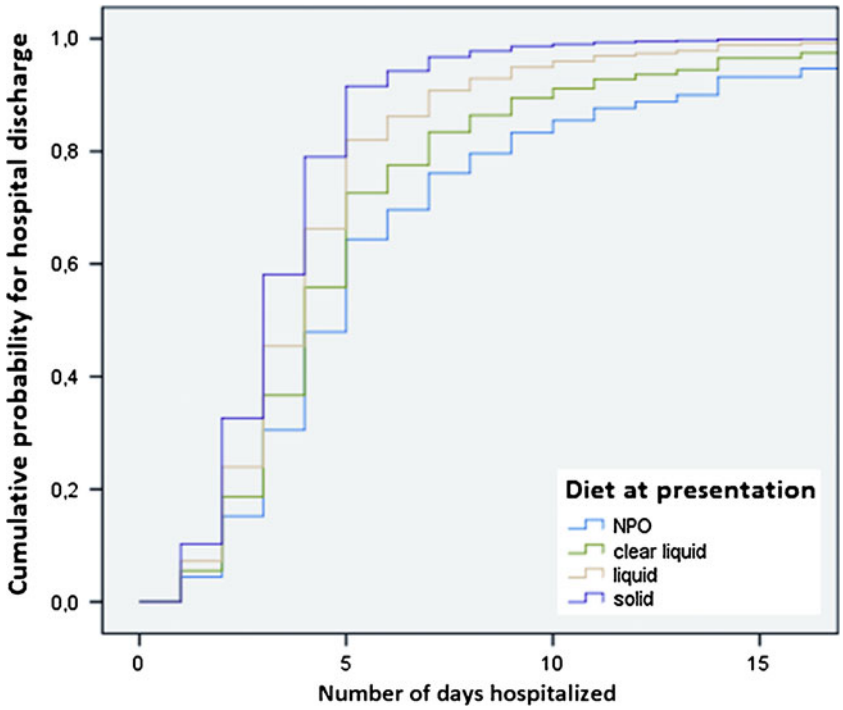

Fig. 2 Cumulative probability curve of number of days hospitalized for nil per os, clear liquid, liquid diet, and solid foods

We did not include clinical parameters in the analysis as study design did not allow for accurate assessment. Although these parameters might have played a role in the diet choice in the present study, it should be questioned whether clinical parameters truly warrant a restricted diet. Is it because these parameters form an indicator for risk of developing complications? If true, then one should ask him/herself whether the choice of diet will influence this chance of complications at all. There is no evidence supporting a relation between diet and the development of complications in patients hospitalized with Hinchey 0, Ia, or Ib diverticulitis; nor do the results of this study support the existence of such a relation. Complications in this study population were extremely rare and did not occur among patients who received solid foods.

The results of this study also demonstrate an inverse relation between length of hospital stay and dietary restrictions. This inverse relation can principally be explained by the ordinal nature of the diet restrictions. It is plausible to assume that physicians tend to discharge patients more easily when they ascertain that patients thrive on a less restrictive diet than initially hospitalized with. Patients starting with a NPO diet, will logically first receive a clear liquid diet before moving too less restricted diets and will, therefore, be hospitalized for a longer period than patients initially hospitalized with solid foods. Results found in this study regarding the number of successive diets per diet imposed at hospitalization support this concept.

This study also found a significant relation between gender and hospitalization duration (Table 5). Male patients with diverticulitis were more likely to be discharged compared to woman. This relation has not previously been described in literature. As, to our knowledge, there is no plausible explanation, this should be further investigated before solid conclusions can be drawn.

Antibiotics are traditionally advised as part of the conservative treatment for diverticulitis. The use of antibiotics in the present study did not shorten hospital stay. Comparable results were found in a recent randomized clinical trial [7]. Moreover, an increasing amount of studies question whether antibiotics should be omitted in the treatment of diverticulitis [8]. Although not the primary aim of this study, we support this view.

This study has certain considerations that must be taken into account when interpreting the results. The retrospective nature of this study inevitably leads to certain amounts of selection and information bias. Nevertheless, the standardized fashion in which data on dietary restrictions was gathered minimizes information bias. Analysis of incomplete cases also did not show any signs for selectively missing data.

Selection bias could not be completely excluded. The flowchart for selection of the study population however did not raise any concern regarding this issue. Moreover, all causal relations were corrected for any residual confounding factors.

One may question whether the study population is large enough to reach statistical significance for describing the relation between Hinchey classification and the diet imposed by the treating physician at presentation. As previously described, the results of this study indicate that patients with a Hinchey Ia episode tend to receive a less restricted diet compared to patients with Hinchey 0. This is in conflict with

the hypothesis that a Hinchey classification and diet type are inversely related. Increasing the sample size might therefore yield a significant result but will not change the conclusion.

With regard to the generalizability of the results, this study was performed in a single center. However, due to the lack of literature and guidelines regarding diet restrictions during the acute phase of diverticulitis, it is likely that the same situation may be found in other centers. This is further strengthened by the diversity of diet regimes used in studies on the efficacy of antibiotic treatment in patients with diverticulitis [9–12].

In conclusion, a diversity of diet restrictions is being used for the treating patients hospitalized with a Hinchey 0–Ib diverticulitis. There is currently no evidence supporting the use of dietary restrictions. Based on our results, employing dietary restrictions might unnecessarily prolong hospital stay. Prospective studies are however needed before solid conclusions on the safety and feasibility of an unrestricted diet can be drawn.

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References

1. Loffeld RJ, van der Putten AB (2002) Newly developing diverticular disease of the colon in patients undergoing repeated endoscopic evaluation. J Clin Gastroenterol 35(2):205–206
2. Jacobs DO (2007) Diverticulitis. N Engl J Med 357:2057–2066
3. Kaiser AM, Jiang JK, Lake JP et al (2005) The management of complicated diverticulitis and the role of computed tomography. Am J Gastronenterol 100:910–917
4. Köhler L, Sauerland S, Neugebauer E, Scientific Committee of the European Association for Endoscopic Surgery (E.A.E.S.) (1999) Diagnosis and treatment of diverticular disease. Surg Endosc 13:430–436
5. Rafferty J, Shellito P, Hyman NH, Standards Committee of The American Society of Colon and Rectal Surgeons et al (2006) Practice parameters for sigmoid diverticulitis. Dis Colon Rectum 49:939–944
6. Tursi A, Elisei W, Brandimarte G et al (2010) Predictive value of serologic markers of degree of histologic damage in acute uncomplicated colonic diverticulitis. J Clin Gastroenterol 44:702–706
7. Chabok A, Påhlman L, Hjern F, Haapaniemi S, Smedh K, AVOD Study Group (2012) Randomized clinical trial of antibiotics in acute uncomplicated diverticulitis. Br J Surg 99(4):532–539. doi:10.1002/bjs.8688, Epub 2012 Jan 30
8. Daniels L, de Korte N, Winter D, Boermeester MA, Stockmann HB (2012) Overtreatment of sigmoid diverticulitis: plea for a less aggressive approach. Dig Dis 30(1):86–91. doi:10.1159/000336261. Epub 2012 May 3
9. Mizuki A, Nagata H, Tatemichi M et al (2005) The out-patient management of patients with acute mild-to-moderate colonic diverticulitis. Aliment Pharmacol Ther 21:889–897
10. Ridgway PF, Latif A, Shabbir J et al (2009) Randomized controlled trial of oral vs intravenous therapy for the clinically diagnosed acute uncomplicated diverticulitis. Colorectal Dis 11:941–946
11. Alonso S, Pera M, Parés D et al. Outpatient treatment of patients with uncomplicated acute diverticulitis. *Colorectal Dis* 2009; DOI:10.1111/j.1463-1318.2009.02122.x
12. Etzioni DA, Chiu VY, Cannom RR et al (2010) Outpatient treatment of acute diverticulitis: rates and predictors of failure. Dis Colon Rectum 53:861–865