The EAES Clinical Practice Guidelines on the Diagnosis and Treatment of Diverticular Disease (1999)

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Introduction

Colonic diverticulosis is an increasingly common condition. About a third of the population is affected by the sixth decade and a half by the ninth decade. The estimated incidence of diverticulitis is approximately ten patients/100,000/year [3, 8]. In the USA, approximately 200,000 admissions to hospital annually are due to diverticular disease. Over the preceding century, the sex predilection has changed from a male to a female predominance. It is well documented that the disease is more common in Western societies than in developing countries [55, 61]; this prevalence can be explained by the etiology of the disease [4]. In East Asia, right-side colonic diverticula or bilateral disease has been found to be more common [54, 58].

Owing to the worldwide importance of the disease and the newly emerging possibilities and controversies in diagnosis and therapy, the European Association for Endoscopic Surgery (EAES) decided to hold a consensus development conference (CDC) during the Sixth International Congress of the EAES, held in Rome, Italy, in 1998.

Methods

With the authorization of the EAES, the planning committee together with the Scientific Committee of the EAES nominated 16 experts as panel members. As with previous conferences [69], the criteria for selection were clinical and scientific expertise in the field of diverticular disease, along with geographical location. In addition, all medical specialties involved in diverticular disease were represented on the panel, so that recommendations would derive from a more complete perspective of the disease.

Prior to the conference, all panelists were asked to search the literature, list all relevant articles, and estimate the strength of evidence for every article cited (see footnote to Table 6.1 for categories of evidence) [1]. They were asked to answer 12 questions on subjects ranging from natural history and diagnosis to aspects of therapy. When assessing laparoscopic sigmoid resection, the levels of technology according to Mosteller [60] and Troidl [83] had to be ranked.

Table 6.1. Laparoscopic surgery for diverticular disease

Stages in technology assessment	Definitely better	Probably better	Similar	Probably worse	Definitely worse	Strength of evidence[a]	References
Feasibility							
Safety/ intraoperative adverse events			X			III	[15, 21, 27, 35, 43, 48, 49, 53, 78, 82, 89, 92]
Operation time				X		III	[15, 21, 27, 35, 43, 48, 49, 53, 78, 82, 89, 92]
Postoperative adverse events		X	X			III	[15, 21, 27, 35, 43, 48, 49, 53, 78, 82, 89, 92]
Mortality			X			III	[15, 21, 27, 35, 43, 48, 49, 53, 78, 82, 89, 92]
Efficacy							
Postoperative pain and other disorders		X				III	[21, 49, 53, 82, 89]
Hospital stay		X				III	[15, 21, 35, 43, 49, 53, 78, 82, 89]
Return to normal activities and work		X				IV	No data
Cosmesis	X					IV	82
Effectiveness (overall assessment)		X				III	

Ia evidence from metaanalysis of randomized controlled trials;
Ib evidence from at least one randomized controlled trial;
IIa evidence from at least one controlled study without randomization;
IIb evidence from at least one other type of quasi-experimental study;
III evidence from descriptive studies, such as comparative studies, correlation studies, and case-control studies;
IV evidence from expert committee reports or opinions or clinical experience of respected authorities, or both
[a] Categories of evidence (as defined by AHCPR [1])

All answers received from the panel members were analyzed and subsequently combined into a provisional preconsensus statement. Each member was then informed about the identity of the other members, which had not been disclosed thus far.

In Rome, all panel members met for a first meeting on June 4, 1998. At this time, the provisional statement was scrutinized, word by word, in a 5-h session. The following day, the modified statement was presented to the audience for public discussion (1.5-h session). During a postconsensus meeting on the same day, all suggestions from the audience were discussed again by the panelists, and the statement was further modified. The final statement was mailed to all panelists for a final Delphi process.

Consensus Statements on Diverticular Disease

1. Definition

In the literature, there is as yet no uniform definition of diverticular disease [30, 36, 80]. Consensus on the following terminology was achieved: Colonic diverticular disease is a condition seen mostly in the sigmoid region. It is characterized structurally by mucosal herniation through the colonic wall, generally accompanied by muscular thickening, elastosis of the taenia coli, and mucosal folding [40, 90]. This condition may be asymptomatic (*diverticulosis*) or associated with "symptoms," termed *diverticular disease*, which may be complicated or uncomplicated. The term *diverticulitis* is used to indicate superadded inflammation involving the bowel wall. Other pathologic complications include perforation, fistula, obstruction, and bleeding.

2. Natural History

The *natural history* of this condition has not been very well investigated within prospective studies [8, 29, 68, 79]. No good indicators are available to distinguish patients who will become symptomatic from those who will not.

3. Etiology

The etiology of diverticular disease is generally accepted as being associated with a lifelong *deficiency of dietary fiber* [19, 22]. It is believed that such a diet results in a small stool, the propulsion of which requires a high intracolonic pressure (equivalent to 150 mmHg or more) [84]. At the vulnerable regions where blood vessels enter the colonic wall, herniation is found. Muscular thickening and elastosis of the taenia coli have also been documented.

A high-roughage diet, such as that consumed by vegetarians, protects against diverticular disease [38]. This type of diet offers an opportunity for

primary disease prevention. In Western countries, however, the decline of dietary fiber intake, mainly from cereal grains, has resulted in a high prevalence of disease, in sharp contrast to the data from developing countries.

Aging is associated with decreased tensile strength of both the collagen and the muscle fibers of the colon. In diverticulosis, similar changes occur, but they exceed the effect ascribed to aging alone [87, 88]. Nevertheless, with increasing age, the prevalence of diverticular disease rises steadily. Moderate and vigorous *physical activity* stimulates bowel activity and therefore may have a protective effect, at least in men [2]. Because *obesity* correlates with low physical activity levels and low fiber intake, it is associated with diverticular disease [74], but it plays no causal role.

Some *hereditary diseases*, such as polycystic kidney disease, Marfan's and Ehlers–Danlos syndrome, are associated with an increased incidence of disease, since, these diseases impair the strength of the submucosa.

Smoking may modestly increase the risk of developing diverticular disease. *Alcohol* and *caffeine* consumption do not play major roles in the etiology [3].

Immunosuppressed patients (mainly transplant recipients) have an increased susceptibility to diverticular disease [25].

Acute attacks of diverticulitis may be associated with hard feces becoming trapped in a diverticulum, causing mucosal ulceration and bacterial migration into the surrounding pericolic fat.

4. Classification

Diverticular disease can be classified with regard to the following aspects of the disease: localization, distribution, clinical symptoms and presentation, and pathology [58]. Two classifications are of importance – the *clinical classification and the Hinchey classification.*

Clinical classification: Subjective disease is difficult to grade, but we consider crampy pain, fever, and subjective patient evaluations to be symptomatic. Disease is classified as follows:

- Symptomatic uncomplicated disease
- Recurrent symptomatic disease
- Complicated disease (hemorrhage, abscess, phlegmon, perforation, purulent and fecal peritonitis, stricture, fistula, small-bowel obstruction due to postinflammatory adhesions)

Hinchey classification: The modified *Hinchey classification* [44, 78] should be used to describe the clinical stages of *perforated diverticular disease:*

- Stage I: pericolic abscess
- Stage II a: distant abscess amenable to percutaneous drainage
- Stage II b: complex abscess associated with/without fistula

- Stage III: generalized purulent peritonitis
- Stage IV: fecal peritonitis

However, neither classification is validated according to established criteria [72].

5. Diagnosis

The choice of diagnostic procedure depends on the clinical presentation. Differential diagnosis in coexisting intestinal disease has to be considered. The first step in making the diagnosis is to establish patient history with respect to type, severity, and course of the symptoms. The second step may require barium enema, colonoscopy, laboratory tests, CT, sonography, or radiograph [18]. The order of the procedures depends on the clinical decision and the availability of the methods.

In *uncomplicated cases*, a colonoscopy with biopsy and/or a barium enema [39, 71] is necessary to rule out adenoma, carcinoma, colitis, and Crohn's disease [64]. There is no consensus on which method should be used first, or whether biopsy is mandatory or recommended.

Patients with *recurrent symptomatic disease* who are eligible for surgery, especially if an endoscopic procedure is planned, should undergo CT and/or barium enema to provide information on location of the disease process, extraluminal changes, and coexisting abdominal abnormalities [10].

In *complicated diverticular disease* (except bleeding) cross-sectional imaging such as computed tomography (CT) should be used in addition to radiography [12, 41, 45, 57, 81]. CT has been reported to have more than 90% sensitivity and specificity [6, 23]. Ultrasonography may serve as another good diagnostic tool [77, 86], but its usefulness depends on the experience of the examiner [75, 91]. If CT is unavailable or does not yield a conclusive diagnosis, a low-pressure, water-soluble contrast enema can be considered. Flexible endoscopy is not recommended in suspected perforation or abscess formation, since it may perforate the colonic wall. The value of magnetic resonance imaging (MRI) has not yet been studied in acute diverticular disease and therefore be evaluated by water-soluble contrast enema to confirm the should be considered experimental.

Cases of *acute obstructive diverticular disease* should obstruction. If the patient has a chronic obstructive situation, colonoscopy with biopsy should be performed.

In cases presenting with *massive bleeding*, a number of different approaches have been used successfully, including selective arteriography, endoscopy, and radionuclide scans [24, 67]. However, there is no consensus on which of these diagnostic tools is preferable as a first choice.

6. Criteria for Making the Treatment Decision

There is general consensus that *disease-dependent criteria* for the treatment decision include number of previous attacks, fever, anemia, leukocytosis, intraluminal narrowing, obstruction, fistulas, abscess formation, free air, intraabdominal fluid, and thickening of the wall verified by CT scan [10, 26].

Patient-dependent criteria include age and concomitant disease, functional and emotional status, degree of disability, cognitive function, and subjective well-being of the patient. However, these criteria have not been thoroughly studied in previous trials.

The number of diverticula, their distribution, and manometry data should have no influence on decision making.

7. Indications for Conservative Treatment

There is a consensus that conservative treatment is indicated in cases with a first attack of uncomplicated diverticulitis [51]. The rationale is that approximately 50–70% of patients treated for a first episode of acute diverticulitis will recover and have no further problems. Only approximately 20% of patients with a first attack develop any complications. Those with recurrent attacks are at 60% risk to develop complications [29]. The members agreed that a detailed description of conservative treatment was outside the scope of the consensus conference, and stated that conservative treatment strategies should be followed as suggested in a recent review article [30]. Appropriate conservative therapy in mild cases consists of oral hydration, oral antibiotics (i.e., ciprofloxacin and metronidazol [66]) and antispasmodics. In moderate or severe cases, oral feeding should be stopped to allow bowel rest [11]. Hydration and antibiotics should be given intravenously. Analgesics can be given as required, including narcotics, but morphine should be avoided because of its potential to cause colonic spasm and hypersegmentation [65].

Patients with diverticular disease who are not suffering from an acute attack should be instructed to maintain a diet high in fiber [19]. Patients who continued to experience discomfort (such as mild cramps, meteorism, or stool irregularities) may benefit from the addition of bulking agents (i.e., plantago) or antispasmodics.

8. Indications for Operative Treatment

There is a consensus that prophylactic sigmoid colectomy is not justified in asymptomatic patients who have no history of inflammatory attacks. There is also agreement that prophylactic sigmoid colectomy should not be performed for symptomatic diverticular disease in the belief that complications

would be prevented thereby. Patients should be considered for elective surgery if they have had at least two attacks of symptomatic diverticular disease [7]. There are no available data on symptoms or signs that might predict the occurrence or severity of an attack. The decision should be made by the treating doctor. At the same time, the benefits of resection for recurrent symptoms must be weighed against the risks of surgery in old, fragile patients and those with concurrent disease. This situation must be fully explained to patients (consensus). Surgery may also be indicated after the first attack in patients who require chronic immunosuppression. Chronic complications such as colovesicular or colovaginal fistulas, stenoses, and bleeding are further indications for operation. If a concomitant carcinoma cannot be excluded, surgery is also recommended.

9. Type of Operation

For *symptomatic, uncomplicated disease*, there is a consensus that the diseased segment – usually the sigmoid colon – should be resected. Sigmoid myotomy is nowadays an outmoded procedure. It is not necessary to remove all diverticula [93]. The distal resection line should be just below the level of the rectosigmoid junction, and anastomosis is performed with the proximal rectum to prevent recurrent disease [37]. The extent to which the colon is resected in the oral direction is controversial. Many surgeons claim that the colon should be divided when the bowel is soft, even in the presence of diverticula; whereas others suggest complete proximal resection of macroscopically involved bowel to achieve normal wall thickness without diverticula at the line of resection. There are insufficient data to resolve this issue [14, 93]. The left ureter should always be identified before resection is performed. During resection, the presacral nerves should be identified and preserved from damage.

Hinchey I (abscess confined to mesentery) should first be treated by percutaneous drainage where possible, followed by sigmoid colectomy and primary anastomosis in fit patients (consensus).

Hinchey II (pelvic abscess, whatever the localization) should also be treated by percutaneous drainage, and followed later by sigmoid resection in most cases, but the risk in patients with comorbidity must be considered in the final decision (consensus) [9].

Hinchey III (purulent peritonitis) is a problematical situation: There are no valid data regarding its best treatment. Options include Hartmann resection, or resection with primary anastomosis with or without a covering stoma [28, 42, 50]. There is a need for randomized trials here (consensus).

Hinchey IV (fecal peritonitis) should be treated by the Hartmann procedure after intense preoperative resuscitation measures [13]. Drainage alone by open operation is not viable for Hinchey III and IV (consensus).

Patients should be informed that the chance of restoring intestinal continuity is only 60% at best after a Hartmann procedure [62]. Open surgery to restore continuity after a Hartmann operation is a major undertaking, and it is associated with a high potential for complications (consensus).

If continuous and severe *bleeding* is caused by diverticular disease, the involved segment should be resected [17, 31, 56, 67]. On-table lavage and endoscopy should be considered to localize the bleeding [5]. However, exact localization is often impossible [32]. In these cases, subtotal colectomy with ileorectal anastomosis is indicated. Selective intraarterial infusion of vasopressin and endoscopic injection hemostasis have been shown to be effective [47, 70], but elective surgery should be considered to prevent recurrence in the long term [20].

10. Place of Laparoscopic Procedures

There is a consensus that elective laparoscopic sigmoid resection (for procedures, see Appendix) may be an acceptable alternative to conventional sigmoid resection in patients with recurrent diverticular disease or stenosis [21, 27, 33, 34, 48, 49, 53, 78] (Table 6.1).

In Hinchey I and II patients, the laparoscopic approach is not the first choice, but it may be justified if no gross abnormalities are found during diagnostic laparoscopy [43]. In some patients, peritoneal lavage or drainage of a localized abscess can be undertaken by laparoscopy [52].

There is no place today for laparoscopic resections in Hinchey III (diverticulitis with purulent peritonitis) and Hinchey IV (diverticulitis with fecal peritonitis) patients [35, 46, 59, 63, 76, 85]. Laparoscopic hookup after a Hartmann resection may reduce morbidity [62], but there may be a high conversion rate.

All surgeons engaged in laparoscopic-assisted sigmoid colectomy must have a low threshold for converting to an open operation if difficulties are encountered or if the anatomy of the abdomen and pelvis cannot be clearly defined [92]. The procedures should be restricted to surgeons experienced in laparoscopic techniques.

11. Laparoscopic Technique

The aim of laparoscopic surgery is to minimize surgical trauma. The same principles as those used in conventional surgery must be applied to the laparoscopic technique.

12. Avoiding Recurrent Disease

In uncomplicated nonoperated cases, recurrent attacks can be prevented by bulking agents, such as plantago. During the operation, the proper height of the proximal resection of the diseased bowel is still a controversial topic [16]. The distal resection should be performed to the level of the rectum, where the taenia disappears [14]. A specimen of 20 cm or more should be resected [16].

13. Long-Term Results and Sequelae of Therapeutic Interventions

In *uncomplicated disease*, the data indicate that a high-fiber diet provides symptomatic relief and protects from complications (below 1% per patient year follow-up) [42].

In *complicated disease*, after successful conservative treatment, the risk of further episodes of complications is approximately 2% per patient year [42, 73]. Resection was required in 3% or less of patients in collected series.

Only a few studies have focused on the outcome for the patients. Quality-of-life measurements are missing. Functional data concerning stool frequency, bowel habits, and continence after the operation are scarce. The persistence of intermitted pain in the lower abdomen after sigmoid resection is surprisingly high (1–27%) [93].

14. Economics

Extensive literature reviews have turned up very little in the way of economic data on the treatment of diverticular disease, especially data that would allow a comparison of treatment options. We recommend that choice of treatment not be based on economic data currently, because costs may vary from one locale to another. Further studies in this area are indicated.

Appendix: Operative Technique for Laparoscopic Sigmoidectomy

The patient is positioned in a modified Trendelenburg position. The pneumoperitoneum should not exceed a pressure of more than 12 mmHg.

Usually four trocars are used, but more trocars can be used in cases of difficulties. The optic trocar is inserted above the umbilicus in the midline. Another 5- or 10-mm trocar is positioned in the left lower quadrant, and two further trocars (10 and 12 mm) are placed in the lower right quadrant.

The dissection begins in the basis of the mesosigmoid, where the vessels are located and divided after identification of the left ureter. Some surgeons prefer the primary mobilization of the sigmoid colon after identification of

the left ureter; others prefer to ligate the superior rectal artery or dissect even closer to the bowel. The mesenteric attachments are freed widely. The parietal peritoneum is divided up to the splenic flexure. Mobilizing the splenic flexure may be useful in creating a tension-free suture. After presacral nerves are identified, the rectosigmoid junction is divided by stapler. A mini-laparotomy is performed in the left lower quadrant, or in the right lower quadrant, or a Pfannenstiel incision is done.

The bowel is extracted through the mini-laparotomy, and proximal resection is completed. Some surgeons use a bag to remove the specimen. The anvil of the stapling device is placed after performing a purse-string suture. After reestablishing the pneumoperitoneum, the stapler is introduced perianally, and the anastomosis is completed. The completeness of the resection ring has to be examined. Integrity of the anastomosis is checked either by endoscope, by air, or by methylene blue-colored water. Drainage of the pelvis is facultative.

References

1. AHCPR (United States Agency for Health Care Policy and Research) (1992) Acute pain management. Operative or medical procedures and trauma. Rockville, MD
2. Aldoori WH, Giovannucci EL, Rimm EB, Ascherio A, Stampfer MJ, Colditz GA, Wing AL, Trichopoulos DV, Willett WC (1995) Prospective study of physical activity and the risk of symptomatic diverticular disease in men. Gut 36:276–282
3. Aldoori WH, Giovannucci EL, Rimm EB, Wing AL, Trichopoulos DV, Willett WC (1995) A prospective study of alcohol, smoking, caffeine, and the risk of symptomatic diverticular disease in men. Ann Epidemiol 5:221–228
4. Almy TP, Howell DA (1980) Diverticular disease of the colon. N Engl J Med 302:324–331
5. Allen Mersh TG (1993) Should primary anastomosis and on-table colonic lavage be standard treatment for left colon emergencies? Ann R Coll Surg Engl 75:195–198
6. Ambrosetti P, Grossholz M, Becker C, Terrier F, Morel P (1997) Computed tomography in acute left colonic diverticulitis. Br J Surg 84:532–534
7. Ambrosetti P, Robert JH, Witzig JA, Mirescu D, Mathey P, Borst F, Rohner A (1994) Acute left colonic diverticulitis in young patients. J Am Coll Surg 179:156–160
8. Ambrosetti P, Robert JH, Witzig JA, Mirescu D, Mathey P, Borst F, Rohner A (1994) Acute left colonic diverticulitis: a prospective analysis of 226 consecutive cases. Surgery 115:546–550
9. Ambrosetti P, Robert J, Witzig JA, Mirescu D, de Gautard R, Borst F, Rohner A (1992) Incidence, outcome, and proposed management of isolated abscesses complicating acute left-sided colonic diverticulitis. A prospective study of 140 patients. Dis Colon Rectum 35:1072–1076
10. Ambrosetti P, Robert J, Witzig JA, Mirescu D, de Gautard R, Borst F, Meyer P, Rohner A (1992) Prognostic factors from computed tomography in acute left colonic diverticulitis. Br J Surg 79:117–119
11. Arfwidsson S (1984) Pathogenesis of multiple diverticula of the sigmoid colon in diverticular disease. Acta Chir Scand [Suppl] 342:1–68
12. Balthazar EJ, Megibow A, Schinella RA, Gordon R (1990) Limitations in the CT diagnosis of acute diverticulitis: comparison of CT, contrast enema, and pathologic findings in 16 patients. Am J Roentgenol 154:281–285

13. Belmonte C, Klas JV, Perez JJ, Wong WD, Rothenberger DA, Goldberg SM, Madoff RD (1996) The Hartmann procedure. First choice or last resort in diverticular disease? Arch Surg 131:616–617
14. Benn PL, Wolff BG, Ilstrup DM (1986) Level of anastomosis and recurrent colonic diverticulitis. Am J Surg 151:269–271
15. Bergamaschi R, Arnaud J (1997) Immediately recognizable benefits and drawbacks after laparoscopic colon resection for benign disease. Surg Endosc 11:802–804
16. Bergamaschi R, Arnaud J (1998) Anastomosis level and specimen length in surgery for uncomplicated diverticulitis of the sigmoid. Surg Endosc 12:1149–1151
17. Bokhari M, Vernava AM, Ure T, Longo WE (1996) Diverticular hemorrhage in the elderly – is it well tolerated? Dis Colon Rectum 39:191–195
18. Brewster NT, Grieve DC, Saunders JH (1994) Double-contrast barium enema and flexible sigmoidoscopy for routine colonic investigation. Br J Surg 81:445–447
19. Brodribb AJM, Humphreys DM (1976) Diverticular disease: three studies. Br Med J 1:424–430
20. Browder W, Cerise EJ, Litwin MS (1986) Impact of emergency angiography in massive lower gastrointestinal bleeding. Ann Surg 204:530–536
21. Bruce CJ, Coller JA, Murray JJ, Schoetz DJ, Roberts PL, Rusin LC(1996) Laparoscopic resection for diverticular disease. Dis Colon Rectum 39:S1–S6
22. Burkitt DP, Walker ARP, Painter NS (1974) Dietary fiber and disease. JAMA 229:1068–1074
23. Cho KC, Morehouse HT, Alterman DD, Thornhill BA (1990) Sigmoid diverticulitis: diagnostic role of CT. Comparison with barium enema studies. Radiology 176:111–115
24. Colombo PL, Todde A, Belisomo M, Bianchi C, Sciutto AM, Tinozzi S (1986) L'emorragia massiva da diverticolosi colica. Ann Ital Chir 65:89–97
25. Detry O, Defraigne JO, Meurisse M, Bertrand O, Demoulin JC, Honore P, Jacquet N, Limet R (1996) Acute diverticulitis in heart transplant recipients. Transpl Int 9:376–379
26. Detry R, Jamez J, Kartheuser A, Zech F, Vanheuverzwijn R, Hoang P, Kestens PJ (1992) Acute localized diverticulitis: optimum management requires accurate staging. Int J Colorectal Dis 7:38–42
27. Eijsbouts QA, Cuesta MA, de Brauw LM, Sietses C (1997) Elective laparoscopic-assisted sigmoid resection for diverticular disease. Surg Endosc 11:750–753
28. Elliott TB, Yego S, Irvin TT (1997) Five-year audit of the acute complications of diverticular disease. Br J Surg 84:535–539
29. Farmakis N, Tudor RG, Keighley MR (1994) The 5-year natural history of complicated diverticular disease. Br J Surg 81:733–735
30. Ferzoco LB, Raptopoulos V, Silen W (1998) Acute diverticulitis. N Engl J Med 338:1521–1526
31. Foutch PG (1995) Diverticular bleeding: are nonsteroidal anti-inflammatory drugs risk factors for hemorrhage and can colonoscopy predict outcome for patients? Am J Gastroenterol 90:1779–1784
32. Forde KA (1981) Colonoscopy in acute rectal bleeding. Gastrointest Endosc 27:219–220
33. Fowler DL, White SA, Anderson CA (1995) Laparoscopic colon resection: 60 cases. Surg Laparosc Endosc 5:468–471
34. Franklin ME (1995) Laparoscopic management of colorectal disease. The United States experience. Dig Surg 12:284–287
35. Franklin ME, Dorman JP, Jacobs M, Plasencia G (1997) Is laparoscopic surgery applicable to complicated colonic diverticular disease? Surg Endosc 11:1021–1025
36. Freeman SR, McNally PR (1993) Diverticulitis. Med Clin North Am 77:1149–1167
37. Frizelle FA, Dominguez JM, Santoro GA (1997) Management of post-operative recurrent diverticulitis: a review of the literature. J R Coll Surg Edinb 42:186–188
38. Gear JSS, Ware A, Fursdon P, Mann JI, Nolan DJ, Brodribb AJM, Vessey MP (1979) Symptomless diverticular disease and intake of dietary fiber. Lancet i:511–514

39. Goldstein NS, Ahmad E (1997) Histology of the mucosa in sigmoid colon specimens with diverticular disease: observations for the interpretation of sigmoid colonoscopic biopsy specimens. Am J Clin Pathol 107:438–444
40. Graser E (1899) Über multiple falsche Darmdivertikel in der Flexura sigmoidea. Münch Med Wochenschr 22:721–723
41. Hachigian MP, Honickman S, Eisenstat TE, Rubin RJ, Salvati EP (1992) Computed tomography in the initial management of acute left-sided diverticulitis. Dis Colon Rectum 35:1123–1129
42. Haglund U, Hellberg R, Johnsén C, Hultén L (1979) Complicated diverticular disease of the sigmoid colon. An analysis of short and long term outcome in 392 patients. Ann Chir Gynaecol 68:41–46
43. Hewett PJ, Stitz R (1995) The treatment of internal fistulae that complicate diverticular disease of the sigmoid colon by laparoscopically assisted colectomy. Surg Endosc 9:411–413
44. Hinchey EJ, Schaal PGH, Richards GK (1978) Treatment of perforated diverticular disease of the colon. Adv Surg 12:85–109
45. Hulnick DH, Megibow AJ, Balthazar EJ, Naidich DP, Bosniak MA (1984) Computed tomography in the evaluation of diverticulitis. Radiology 152:491–495
46. Khan AL, Ah See AK, Crofts TJ, Heys SD, Eremin O (1995) Surgical management of the septic complications of diverticular disease. Ann R Coll Surg Engl 77:16–20
47. Kim YI, Marcon NE (1993) Injection therapy for colonic diverticular bleeding. A case study. J Clin Gastroenterol 17:46–48
48. Köckerling F, Schneider C, Reymond MA, Scheidbach H, Konradt J, Bärlehner E, Bruch HP, Kuthe A, Troidl H, Hohenberger W, Laparoscopic Colorectal Study Group (1998) Early results of a prospective multicenter study on 500 consecutive cases of laparoscopic colorectal surgery. Surg Endosc 12:37–41
49. Köhler L, Rixen D, Troidl H (1998) Laparoscopic colorectal resection for diverticulitis. Int J Colorect Dis 13:43–47
50. Kronborg O (1993) Treatment of perforated sigmoid diverticulitis: a prospective randomized trial. Br J Surg 80:505–507
51. Larson DM, Masters SM, Spiro HM (1976) Medical and surgical therapy in diverticular disease. A comparative study. Gastroenterology 71:734–737
52. Lee EC, Murray JJ, Coller JA, Roberts PL, Schoetz DJ (1997) Intraoperative colonic lavage in nonelective surgery for diverticular disease. Dis Colon Rectum 40:669–674
53. Liberman MA, Phillips EH, Carroll BJ, Fallas M, Rosenthal R (1996) Laparoscopic colectomy vs traditional colectomy for diverticulitis: outcome and costs. Surg Endosc 10:15–18
54. Lo CY, Chu KW (1996) Acute diverticulitis of the right colon. Am J Surg 171:244–246
55. Manousos O, Day NE, Tzonou A, Papadimitriou C, Kapetanakis A, Polychronopoulou-Trichopoulou A, Trichopoulos D (1985) Diet and other factors in the aetiology of diverticulosis: an epidemiological study in Greece. Gut 26:544–549
56. McGuire HH (1994) Bleeding colonic diverticula. A reappraisal of natural history and management. Ann Surg 220:653–656
57. McKee RF, Diegnan RW, Krukowski ZH (1993) Radiological investigation in acute diverticulitis. Br J Surg 80:560–565
58. Miura S, Kodaira S, Aoki H, Hosoda Y (1996) Bilateral type diverticular disease of the colon. Int J Colorectal Dis 11:71–75
59. Morton DG, Keighley MR (1995) Prospektive nationale Studie zur komplizierten Diverticulitis in Grossbritannien. Chirurg 66:1173–1176
60. Mosteller F (1985) Assessing medical technologies. National Academic Press, Washington, DC
61. Munakata A, Nakaji S, Takami H, Nakajima H, Iwane S, Tuchida S (1993) Epidemiological evaluation of colonic diverticulosis and dietary fiber in Japan. Tohoku J Exp Med 171:145–151

62. Navarra G, Occhionorelli S, Marcello D, Bresadola V, Santini M, Rubbini M (1995) Gasless video-assisted reversal of Hartmann's procedure. Surg Endosc 9:687–689
63. O'Sullivan GC, Murphy D, O'Brien MG, Ireland A (1996) Laparoscopic management of generalized peritonitis due to perforated colonic diverticula. Am J Surg 171:432–434
64. Padidar AM, Jeffrey RB, Mindelzun RE, Dolph JF (1994) Differentiating sigmoid diverticulitis from carcinoma on CT scans: mesenteric inflammation suggests diverticulitis. Am J Roentgenol 163:81–83
65. Painter NA (1968) Diverticular disease of the colon. Br Med J 3:475–479
66. Papi C, Ciaco A, Koch M, Capurso L (1995) Efficacy of rifaximin in the treatment of symptomatic diverticular disease of the colon. A multicenter double-blind placebo-controlled trial. Aliment Pharmacol Ther 9:33–39
67. Parkes BM, Obeid FN, Sorensen VJ, Horst HM, Fath JJ (1993) The management of massive lower gastrointestinal bleeding. Am Surg 59:676–678
68. Parkes TG (1969) Natural history of diverticular disease of the colon. A review of 521 cases. Br Med J 4:639–645
69. Paul A, Millat B, Holthausen U, Sauerland S, Neugebauer E, for the Scientific Committee of the European Association of Endoscopic Surgery (1998) Diagnosis and treatment of common bile duct stones (CBDS): results of a consensus development conference. Surg Endosc 12:856–864
70. Ramirez FC, Johnson DA, Zierer ST, Walker GJ, Sanowski RA (1996) Successful endoscopic hemostasis of bleeding colonic diverticula with epinephrine injection. Gastrointest Endosc 43:167–170
71. Rex DK, Mark D, Clarke B, Lappas JC, Lehman GA (1995) Flexible sigmoidoscopy plus air-contrast barium enema versus colonoscopy for evaluation of symptomatic patients without evidence of bleeding. Gastrointest Endosc 42:132–138
72. Rothman KJ, Greenland S (eds) (1998) Modern epidemiology. 2nd ed. Lippincott-Raven, Philadelphia
73. Sarin S, Boulos PB (1994) Long-term outcome of patients presenting with acute complications of diverticular disease. Ann R Coll Surg Engl 76:117–120
74. Schauer PR, Ramos R, Ghiatas AA, Sirinek KR (1992) Virulent diverticular disease in young obese men. Am J Surg 164:446–448
75. Schiller VL, Schreiber L, Seaton C, Sarti DA (1995) Transvaginal sonographic diagnosis of sigmoid diverticulitis. Abdom Imaging 20:253–255
76. Schulz C, Lemmens HP, Weidemann H, Rivas E, Neuhaus P (1994) Die Resektion mit primärer Anastomose bei der komplizierten Diverticulitis. Eine Risikoanalyse. Chirurg 65:50–53
77. Schwerk WB, Schwarz S, Rothmund M (1992) Sonography in acute colonic diverticulitis. A prospective study. Dis Colon Rectum 35:1077–1084
78. Sher ME, Agachan F, Bortul M, Nogueras JJ, Weiss EG, Wexner SD (1997) Laparoscopic surgery for diverticulitis. Surg Endosc 11:264–267
79. Sheppard AA, Keighley MRB (1986) Audit of complicated diverticular disease. Ann R Coll Surg Engl 68:8–10
80. Standards Task Force, American Society of Colon and Rectal Surgeons (1995) Practice parameters for sigmoid diverticulitis. Dis Colon Rectum 38:125–132
81. Stefansson T, Nyman R, Nilsson S, Ekbom A, Pahlman L (1997) Diverticulitis of the sigmoid colon. A comparison of CT, colonic enema and laparoscopy. Acta Radiol 38:313–319
82. Stevenson AR, Stitz RW, Lumley JW, Fielding GA (1998) Laparoscopically assisted anterior resection for diverticular disease: follow-up of 100 consecutive patients. Ann Surg 227:335–342
83. Troidl H (1994) Endoscopic surgery – a fascinating idea requires responsibility in evaluation and handling. In: Szabó Z, Kerstein MD, Lewis JE (eds) Surgical technology international III. Universal Medical Press, San Francisco, pp 111–117
84. Trotman IF, Misiewicz JJ (1988) Sigmoid motility in diverticular disease and the irritable bowel syndrome. Gut 29:218–222

85. Tucci G, Torquati A, Grande M, Stroppa I, Sianesi M, Farinon AM (1996) Major acute inflammatory complications of diverticular disease of the colon: planning of surgical management. Hepatogastroenterology 43:839–845
86. Verbanck J, Lambrecht S, Rutgeerts L, Ghillebert G, Buyse T, Naesnes M, Tytgat H (1989) Can sonography diagnose acute colonic diverticulitis in patients with acute intestinal inflammation? A prospective study. J Clin Ultrasound 17:661–666
87. Wess L, Eastwood MA, Edwards CA, Busuttil A, Miller A (1996) Collagen alteration in an animal model of colonic diverticulosis. Gut 38:701–706
88. Wess L, Eastwood MA, Wess TJ, Busuttil A, Miller A (1995) Cross linking of collagen is increased in colonic diverticulosis. Gut 37:91–94
89. Wexner SD, Reissman P, Pfeifer J, Bernstein M, Geron N (1996) Laparoscopic colorectal surgery. Surg Endosc 10:133–136
90. Whiteway J, Morson BC (1985) Elastosis in diverticular disease of the sigmoid colon. Gut 26:258–266
91. Wilson SR, Toi A (1990) The value of sonography in the diagnosis of acute diverticulitis of the colon. Am J Roentgenol 154:1199–1202
92. Wishner JD, Baker JW, Hoffman GC, Hubbard GW, Gould RJ, Wohlgemuth SD, Ruffin WK, Melick CF (1995) Laparoscopic-assisted colectomy: the learning curve. Surg Endosc 9:1179–1183
93. Wolff BG, Ready RL, MacCarty RL, Dozois RR, Beart RW (1984) Influence of sigmoid resection on progression of diverticular disease of the colon. Dis Colon Rectum 27:645–647