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Diagnosis and treatment of diverticular disease

Results of a consensus development conference

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Abstract
Background: With the aim of resolving the current controversy over the diagnosis and treatment of diverticular disease, this consensus development conference set out to summarize the actual state of the art.
Methods: A multidisciplinary panel of international experts ($n = 16$) was selected to take part in the consensus process. Prior to the conference, all experts were asked to answer a series of questions on diverticular disease. The consensus statement compiled out of these evaluations was modified during a joint meeting of the panel members, then presented for discussion in a public session, and finally revised by the expert panel. The finalized statement was mailed to all panel members for approval (Delphi method).
Results: Asymptomatic diverticulosis, diverticular disease (with actual or recurrent symptoms), and complicated diverticular disease were defined separately. No agreement was reached on whether barium enema or colonoscopy is the better choice as an initial diagnostic tool in uncomplicated cases. In complicated cases, computed tomography is recommended for diagnosis. After two attacks of diverticular disease, elective resection should be considered. For patients in whom a concomitant carcinoma cannot be excluded and those with chronic complications (fistula, stenosis, or bleeding) surgery is also indicated. Laparoscopic sigmoid colectomy is recommended only for uncomplicated and, after percutaneous drainage of abscesses, Hinchey stage I and II cases.
Conclusions: Laparoscopic surgery has already begun to influence the management of diverticular disease, but the randomized controlled trials needed to support therapy decisions are largely missing.

Key words: Consensus development conference — Diverticulitis — Contrast enema — Hartmann resection — Laparoscopic colectomy — Intraabdominal infections

Colonic diverticulosis is an increasingly common condition. About a third of the population is affected by the 6th decade and a half by the 9th decade. The estimated incidence of diverticulitis is ~10 patients/100,000/year [3, 8]. In the United States, ~200,000 admissions to hospital annually are

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Table 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	

[a] Categories of evidence (as defined by AHCPR [1]).
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.

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 (E.A.E.S.) decided to hold a consensus development conference (CDC) during the Sixth International Congress of the E.A.E.S., held in Rome, Italy, in 1998.

Methods

With the authorization of the E.A.E.S., the planning committee together with the Scientific Committee of the E.A.E.S. 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 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.

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 ½-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) [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 IIa: distant abscess amenable to percutaneous drainage
- stage IIb: 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 >90% sensitivity and specificity [23, 6]. 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 should be considered experimental.

Cases of *acute obstructive diverticular disease* should be evaluated by water-soluble contrast enema to confirm the

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 ~50–70% of patients treated for a first episode of acute diverticulitis will recover and have no further problems. Only ~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 local-

ization 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 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 $\geq$20 cm 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 (<1% per patient year follow-up) [42].

In *complicated disease*, after successful conservative treatment, the risk of further episodes of complications is ~2% per patient year [42, 73]. Resection was required in $\leq$3% 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 >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 peranally, 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.

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