Diverticula and Diverticulitis: Time for a Reappraisal

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Abstract: Colonic diverticula are very common and may be associated with symptoms or complicated by diverticulitis and its associated problems. Many of the traditional concepts relating to the pathophysiology, prevention, and management of these entities have been questioned recently based on findings from high-quality prospective studies. Although dietary fiber may protect against symptoms and complications, its impact on the formation of diverticula may be limited. It is now evident that the risk for an episode of diverticulitis in an individual with diverticula is lower than previously thought. Furthermore, the necessity for antibiotic use in uncomplicated diverticulitis has been questioned and serious doubt cast upon the belief that surgery should be performed when a second attack occurs. Although data are far from conclusive, there is some evidence to suggest that diverticulosis may be associated with chronic abdominal symptoms, with or without underlying chronic inflammatory changes in the involved segment of the colon. In addition, colonoscopy is not routinely required after an attack of acute uncomplicated diverticulitis, as the risk of cancer in this population is not much higher than in the general population.

Keywords
Diverticulosis, diverticular disease, diverticulitis, diverticula, fiber, antibiotics, surgery

Diverticular disease of the colon, a broad umbrella concept used to encompass all clinical manifestations of colonic diverticula (pouches), is a very common condition in the Western world; in 2009, it was the sixth most common outpatient gastrointestinal diagnosis and the third most common discharge diagnosis among hospital admissions in the United States.[1] Diverticulosis, or the mere presence of diverticula, increases in incidence with aging; less than 20% of individuals with the condition are younger than 40 years, and more than 70% of patients are older than 80 years.[2-4]

A diverticulum was first described anatomically by Littré in 1700, according to a book by Morgagni.[5] Multiple reports were published by anatomic pathologists throughout the 19th century, mostly based on observations made at autopsies. Diverticulitis, or

inflammation or infection of diverticula, was first recognized as a clinical entity around this time; in 1896, Mayo operated on a patient with a colovesical fistula secondary to diverticulitis.[6]

Because most patients with diverticulosis are asymptomatic, the true incidence of diverticula (or diverticulosis) is difficult to determine, with most estimates derived from sources that may be subject to considerable selection bias (eg, autopsy, imaging, colonoscopy). Furthermore, most of the data quoted for the epidemiology of diverticula come from studies published over 30 years ago. For example, Welch and colleagues reported on a consecutive series of 2000 barium enemas in 1953, in which over two-thirds of patients older than 85 years had diverticulosis.[7] A recent endoscopic series found diverticulosis in 71% of colonoscopies in patients older than 80 years.[4] Diverticula are more prevalent in the left colon, except in Asian countries, where they are more common on the right side of the colon. Although the incidence of diverticula appears to be on the rise in the Western world, the condition remains very rare in rural Africa and Asia.[8] As countries become urbanized, the incidence of the condition appears to increase.

Although diverticula are, by definition, asymptomatic, approximately 20% of affected individuals report abdominal symptoms. It is unclear whether this association merely represents comorbidity with irritable bowel syndrome (IBS), which is prevalent in approximately 20% of the adult population in the West, or whether the association constitutes a distinct clinical entity (such as painful diverticular disease), as some researchers have suggested. The well-recognized complications of diverticula—bleeding, diverticulitis, and related problems such as abscesses, free perforations, fistulae, and strictures—are more clinically clearcut.[9,10] The incidence of complications attributable to diverticula also appears to be increasing. Nguyen and colleagues found an increase in the rate of hospitalization for diverticulitis in the United States between 1998 and 2005, from 61.8 per 100,000 individuals to 75.5 per 100,000 individuals, especially in those younger than 45 years.[11]

Over the years, a number of concepts related to diverticula and their natural history have been advanced, usually on an empiric basis, and have become embedded in daily clinical practice. In this article, we will attempt to reexamine these ideas, as others have done,[12] in the light of more recent data.

A Low-Fiber Diet Vs a High-Fiber Diet in Patients With Diverticular Disease

The role of dietary fiber in the pathogenesis of diverticulosis was popularized by Painter and Burkitt in 1971.[13] The authors observed that diverticulosis was rare in rural Africa but common in economically developed countries, a difference they attributed to extreme variations in dietary fiber. They believed that diet in rural Africa was high in dietary fiber and that economically developed countries consumed a low-fiber diet. They presumed that this deficiency in fiber predisposed Western populations to diverticulosis.

In another study, Painter and colleagues suggested that a low-fiber diet led to constipation and high-pressure segmenting contractions in the sigmoid colon, which resulted in mucosal herniation through weak spots in the colonic wall.[14] The authors conducted motility studies comparing intracolonic pressures in patients with diverticulosis with those of controls and concluded that patients with diverticulosis had increased colonic pressures; however, pressure measurements were reported only for select cases, and no statistical analysis was performed. Burkitt and colleagues conducted colonic transit studies and found that patients on a Western diet had longer mean colonic transit times and lower mean stool weights compared with African populations.[15]

Recent studies, however, have yielded less conclusive results regarding the role of fiber intake in diverticulosis. In a cross-sectional study among subjects undergoing colonoscopy, Peery and colleagues failed to confirm that a low-fiber diet and constipation were risk factors for diverticulosis[16] and failed to identify a protective role for a high-fiber diet.[3] Crowe and colleagues examined associations between a vegetarian diet and the intake of fiber and the risk of diverticular disease in more than 47,000 individuals participating in the EPIC (European Prospective Investigation Into Cancer and Nutrition)-Oxford study.[17] Vegetarians, who made up one-third of the subjects, demonstrated a 31% lower risk of diverticular disease in comparison with meat eaters. Participants whose fiber intake was in the highest quintile had a 41% lower risk of diverticular disease. Interestingly, fiber appeared to be protective against both complicated and uncomplicated diverticular disease. The authors concluded that consuming a vegetarian diet with a high fiber intake was associated with a lower risk of hospital admission or death from diverticular disease.[17]

In 2 separate studies based on the HPFS (Health Professionals Follow-up Study), Aldoori and colleagues analyzed data from a prospective cohort of 43,811 male health professionals aged 40 to 75 years.[18,19] The authors found that, after correcting for age, energy-adjusted total fat intake, and physical activity, fiber intake was inversely associated with the risk for symptoms attributed to diverticular disease.[18] Indeed, the risk was almost halved for those in the highest quintile of fiber intake. In a separate study, Aldoori and colleagues found that it was, in particular, the insoluble component of fiber (cellulose) that was most protective.[19]

A more recent study, published by Crowe and colleagues on behalf of the Million Women Study, also suggested that a higher intake of dietary fiber was associated with a decreased risk of diverticular disease.[20] More than 690,000 women without diverticular disease at baseline were followed for 6 years. The relative risk of diverticular disease per 5 g/day of fiber intake was 0.86 (95% CI, 0.84-0.88). Association with diverticular disease varied with the source of fiber, with the reduction in risk being greater for cereals and fruits.[20]

Although it seems conceptually attractive and reasonable to hypothesize that a high-fiber diet protects against the development of diverticular disease, not all of the available data support this notion. Therefore, researchers have wondered how to reconcile these apparently contradictory findings. Several factors may contribute to the starkly different conclusions reached by Peery and colleagues[3,16] vs those reached by Crowe and colleagues[17,20] and Aldoori and colleagues.[18,19] These factors include study population (subjects undergoing a screening colonoscopy vs the general population), study design (cross-sectional vs prospective), and, perhaps most importantly, the methods used to diagnose the diverticula and the study endpoint. In the studies by Peery and colleagues,[3,16] the diverticula were identified at colonoscopy, whereas in the studies by Aldoori and colleagues[18,19] and Crowe and colleagues,[17,20] diverticulosis was diagnosed on the basis of patient history alone. As for the other important factor, the study endpoint, Peery and colleagues[3,16] examined correlations in their cross-sectional colonoscopic studies between various factors and the presence of diverticula (asymptomatic diverticulosis), whereas the endpoints in the prospective studies of Aldoori and colleagues[18,19] and Crowe and colleagues[17,20] were either symptomatic diverticular disease or a hospital admission for diverticular disease or a complication thereof. These studies are, therefore, examining 2 very different entities: symptomatic or complicated diverticular disease vs asymptomatic diverticulosis. It could be tentatively concluded that, although a high-fiber diet may protect against complications of diverticula or against diverticula becoming symptomatic, it may not prevent the formation of diverticula in the first place. Therefore, in the context of diverticular disease, it remains prudent to continue to recommend a high-fiber diet not only in light of its possible impact on the natural history of diverticulosis, but also based on the additional health benefits that it may offer.[21]

Consumption of Nuts, Seeds, Corn, and Popcorn

The notion that individuals with diverticula should avoid nuts, seeds, corn, and popcorn is enshrined in medical lore and based on the hypothesis that these indigestible items or their fragments could impact and obstruct a diverticulum, thereby causing diverticulitis or a diverticular hemorrhage. However, a large prospective study, which examined 47,228 men aged 40 to 75 years who participated in the HPFS and were followed for more than 20 years, documented an inverse relationship between nut and popcorn consumption and the risk of diverticulitis. Furthermore, no associations were observed between corn consumption and diverticulitis or between nut, corn, or popcorn consumption and diverticular hemorrhage or uncomplicated diverticulosis.[22] This study was instrumental in putting to rest the nut, seed, corn, and popcorn hypothesis; therefore, avoidance of these foods is no longer recommended.

Risks for Diverticulitis and Its Recurrence

Estimates of the risk for the development of diverticulitis, as well as for the recurrence of the condition following a first or subsequent attack, have played a fundamental role in defining the clinical approach to the management of diverticular disease. Acute diverticulitis is one of the more common complications of diverticular disease and was traditionally thought to occur in as many as 25% of subjects endowed with diverticula.[23,24] It is now apparent that this has been a gross overestimation of risk, as more recent (albeit retrospective) data using more objective criteria for both diverticulosis and diverticulitis have indicated that, over an 11-year follow-up period, the risk of developing an episode of acute diverticulitis was 4%, or as low as 1% with a more rigorous definition of diverticulitis (confirmed by imaging or surgery).[25] Interestingly, the risk for diverticulitis in this study was higher among younger patients.[25]

Even more critical to patient management have been estimates of the risk of recurrence following a first or subsequent attack of diverticulitis. Initial estimates of recurrence, based largely on retrospective hospital-based surgical series, suggested that after an initial attack, approximately 33% of patients will experience a recurrence, and one-third of those patients will have a second recurrence.[23,26,27] For example, in 1969, Parks reported a recurrence rate as high as 45% in a cohort of 455 patients, with subsequent attacks being less responsive to medical therapy.[23] These data, together with the belief that subsequent episodes were more likely to be complicated, led to the widely applied recommendation for elective colectomy after 2 episodes of uncomplicated diverticulitis or 1 episode of complicated diverticulitis.

More recent data, however, have not only reported lower recurrence rates (13%-23%) but have also questioned the notion that subsequent episodes are more severe, with rates of subsequent complicated disease or need for

emergency surgery reported to be as low as 6%.[28-31] Furthermore, these recent studies have also shown that the risk for recurrent hospitalization for diverticulitis is similar for patients treated medically or surgically.[32] In one of the largest studies to date, derived from the California Office of Statewide Health Planning and Development database, 210,268 patients with diverticulitis were identified and their outcomes determined.[31] Of those managed medically, 16.3% experienced a second attack. Interestingly, mortality for delayed elective surgery following the first episode was only 0.3%, in contrast with 4.6% for emergency resection following the second episode, suggesting that, although the risk of recurrence may be lower than previously estimated, there are risks, albeit small, associated with emergency surgery if there is a recurrence. It may be possible to identify patients at greatest risk based on demographics and other characteristics; in the study from California, the authors identified age older than 50 years, tobacco use, and a complicated initial presentation as predictors of mortality upon recurrence.[31]

Although older literature recommended surgery after 2 attacks of diverticulitis,[33] there is no evidence to support this approach[34]; indeed, more recent data indicate that patients who have experienced 2 or more episodes of diverticulitis are not at an increased risk for morbidity or mortality, even if surgical intervention is necessary.[35]

The above data led the American Society of Colon and Rectal Surgeons to revise its clinical practice guidelines to recommend that elective sigmoid colectomy after recovery from uncomplicated acute diverticulitis should not be mandated based on any defined rule but, rather, should be individualized.[36] Although consensus has not been achieved on this issue,[37] most physicians would suggest that surgery should, at the very least, be considered following an episode of complicated diverticulitis.[36]

A number of medical strategies involving mesalamine, rifaximin (Xifaxan, Salix), and probiotics have been studied in terms of their potential to prevent recurrence or the development of symptoms presumed to be linked to diverticula following an episode of acute diverticulitis.[38] Although several studies have suggested some reduction in symptoms (eg, with rifaximin), none of these strategies have consistently and convincingly shown clinically significant benefit.[38]

Antibiotics in Uncomplicated Diverticulitis

Traditionally, antibiotics have been recommended for the management of an episode of acute diverticulitis, complicated or not; however, more recent reviews of this issue have suggested that antibiotics may not play a critical role in the management of uncomplicated diverticulitis. Isacson and colleagues conducted a retrospective population-based cohort study of 246 patients with computed tomography (CT)-verified diverticulitis.[39] Uncomplicated diverticulitis was reported in 195 patients, of whom 91% were managed without the use of antibiotics. The readmission rate with this approach was 3.4%, and 2 patients (1.13%) developed an abscess.[39] The authors went on to prospectively study a management approach to uncomplicated acute diverticulitis that again excluded the use of antibiotics and was performed exclusively in an outpatient setting. Of the 155 patients treated with this approach, failure was encountered in only 4 (2.6%). Based on these findings, the authors concluded that a no-antibiotic outpatient care policy was appropriate and safe in the management of acute uncomplicated diverticulitis.[40]

Even more convincing than the aforementioned retrospective and observational studies was a randomized trial conducted by Chabok and colleagues on 623 patients with CT-verified acute uncomplicated diverticulitis.[41] No differences were detected between the groups that did and did not receive antibiotics in terms of complications (eg, perforation, abscess formation), length of hospital stay, or 1-year readmission rates.

The above studies support reserving antibiotic therapy for complicated diverticulitis. This represents a marked deviation from traditional thinking in the management of acute diverticulitis; thus, it may take some time until physicians, particularly primary care doctors, are comfortable with this approach.

The Relationship Between Diverticulosis and Chronic Gastrointestinal Symptoms and Quality of Life

Diverticulosis, as previously mentioned, is the presence of diverticula and is asymptomatic until it is complicated by diverticulitis or 1 of its complications, such as obstruction (although this occurs in only a minority of individuals with diverticula). Accordingly, diverticulosis is not considered a disease until symptoms occur. In the past, the term *diverticular disease* was used rather loosely to describe individuals with diverticula who experience symptoms, such as left lower quadrant pain and an altered bowel habit, which were typically intermittent and separated by clinically asymptomatic periods. With the growing recognition of IBS as a distinct entity, such symptoms were regarded as reflecting the occurrence of IBS in an individual who happened to have diverticula; thus, the concepts of diverticular disease and painful diverticular disease passed out of favor, and the use of these terms was discouraged.

More recently, a growing body of data has emerged to suggest that diverticulosis may be a chronic bowel disease with both physical and psychological manifestations caused by recurrent abdominal symptoms. Thus, it is increasingly

recognized that, for some patients, diverticulitis-related symptoms may persist beyond the acute phase, evolving into a chronic illness with a lower health-related quality of life.[42] Bolster and Papagrigoriadis were among the first researchers to demonstrate, albeit in a preliminary study, that diverticular disease had a negative impact on quality of life, regardless of age or sex.[43] In a subsequent study of 58 consecutive outpatients with symptomatic uncomplicated diverticular disease (SUDD), Comparato and colleagues evaluated quality of life using the 36-Item Short-Form Health Survey (SF-36) at baseline and after 6 months of therapy with rifaximin or mesalamine.[44] At baseline, all of the patients had mean scores below optimal levels; after 6 months of therapy with either regimen, SF-36 scores improved for almost all physical and psychological domains. The authors concluded that not only does diverticular disease negatively impact quality of life, but also that this effect may be reversible with successful treatment.

Despite these observations, diverticulosis should not be considered a disease but rather a preexisting condition that may or may not become symptomatic. Only when symptoms appear should the term *diverticular disease* be considered, and even then it should be used with much caution. SUDD has been used to describe persistent and recurrent abdominal symptoms attributed to diverticula in the absence of demonstrable inflammatory changes in the colonic mucosa.

Overlap with, and distinction from, IBS remains an issue. For now, the relationship between IBS and diverticular disease is poorly defined, and determining which condition is causing symptoms can be challenging. The 2 entities may actually be linked. A population-based, cross-sectional survey of residents of Olmstead County, Minnesota who were between the ages of 30 and 95 years reported increased odds for diverticulosis in patients with IBS compared with patients without IBS. Interestingly, although IBS was associated with a significantly greater odds ratio (OR) for diverticulosis (OR, 1.8; 95% CI, 1.3-2.4), this did not hold true for diverticulitis (OR, 1.7; 95% CI, 0.9-3.2).[45] The association with diverticulosis was strongest for patients older than 65 years (OR, 9.4; 95% CI, 5.8-15.1), and diverticular disease was linked with diarrhea-predominant IBS and mixed IBS (OR, 1.9; 95% CI, 1.1-3.2 and OR, 2.6; 95% CI, 1.0-6.4, respectively).[45] The latter finding may come as a surprise to some physicians, as conventional wisdom would have predicted that this relationship would be strongest with constipation-predominant IBS; however, the authors did not find a significant association between this IBS subtype and diverticular disease.[45]

To complicate matters further, colonoscopic data suggest that diverticulitis may be more common than imagined and may not necessarily be symptomatic. Indeed, with the proliferation of colonoscopy for colorectal cancer screening, asymptomatic acute diverticulitis is occasionally diagnosed during an elective examination. Ghorai and colleagues[46] reported endoscopic signs of acute diverticulitis in 0.8% of 2566 patients who underwent an elective colonoscopy. Findings included granulation tissue protruding from a diverticulum (the most common finding), erythema and edema at a diverticular opening, and pus draining from a diverticulum. None of these patients had a clinical suspicion of acute diverticulitis prior to undergoing colonoscopy. Only 1 patient was found to have symptoms of diverticulitis at the time of colonoscopy. These observations raise the possibility that diverticulitis may initially be subclinical, only to present later as recurrent symptoms that are mislabeled as SUDD or mistakenly included under the label of IBS, a concept supported by other observations, which are discussed below.

Chronic low-grade inflammation related to diverticula has been identified in 2 different conditions: chronic recurrent diverticulitis and segmental colitis associated with diverticulosis (SCAD). Although the role of inflammation in acute diverticulitis is universally accepted, the concept of a chronic inflammatory state in diverticulosis is a recent development. Inflammatory changes may be microscopic only, or they may be macroscopic, at times even simulating inflammatory bowel disease. Narayan and Floch[47] reported findings of mild chronic inflammation in 13 of 17 patients with uncomplicated diverticulosis. Biopsies were randomly obtained in proximity to diverticula in the descending and sigmoid colon. In a larger series, Horgan and colleagues[48] identified 47 patients with what they termed atypical smoldering diverticular disease among a total of 930 patients who underwent sigmoid resection for diverticular disease over a 10-year period. Of these 47 patients, 76% had evidence of acute or chronic inflammatory changes in the resected specimens. After surgery, 88% were pain-free, with complete resolution of symptoms experienced in 76.5%. Therefore, the available data support the concept that microscopic inflammation occurs in patients with diverticulosis and may contribute to chronic symptoms.

SCAD is a form of macroscopic colitis that has been documented in association with diverticula. SCAD typically affects the mucosa in areas of diverticula and spares the rectum and proximal colon. This condition is rare; it was reported in only 0.25% of patients undergoing colonoscopy in a prospective, multicenter study from Italy.[49] The inflammatory changes characteristically spare the diverticula, with histologic features similar to those of idiopathic inflammatory bowel disease, as well as infectious and ischemic colitis.[50-52] Affected individuals are usually older than 60 years, are predominantly male, and present with hematochezia in the absence of systemic symptoms.

Some patients may also complain of abdominal pain and diarrhea. Endoscopic examinations reveal inflammatory changes limited to interdiverticular mucosa. The mucosa appears erythematous, friable, and granular, in either a diffuse or patchy distribution. In general, the endoscopic features are nonspecific and may resemble inflammatory bowel disease (either Crohn's disease or ulcerative colitis). In addition, the histopathology of SCAD is indistinguishable from that of ulcerative colitis and Crohn's disease.[51-53] A retrospective study of 29 patients with concurrent Crohn's disease and diverticulitis found no distinguishing pathologic features between resected sigmoid specimens from patients with Crohn's disease (confirmed by involvement of other segments of the intestine) and those from individuals with Crohn's disease–like SCAD.[54] In a prospective study of 5457 consecutive colonoscopic examinations performed at 5 centers in Italy, 30 patients were identified with inflammatory bowel disease–like lesions limited to colonic segments, which included diverticula; of these, 14 fulfilled criteria for SCAD. The histologic findings were not diagnostic, and most patients were asymptomatic at 12-month follow-up.[49]

SCAD appears to represent an independent clinical and pathologic entity with an unknown etiology, inflammatory bowel disease–like characteristics, location limited to areas of the colon incorporating the diverticula, and a self-limited course. For now, treatment is symptomatic and directed at the dominant symptom, be it pain or altered bowel habit; to date, high-quality randomized clinical trials of anti-inflammatory drugs commonly used in the management of classic inflammatory bowel disease have not been performed.

In summary, these recent data suggest that diverticulosis can be associated with, and diverticulitis followed by, recurrent or chronic abdominal symptoms long after the acute event has resolved. The term *chronic diverticulitis*, however, should be used cautiously, as the inflammatory conditions described above do not represent chronic inflammation of the diverticula themselves, but rather variable forms of colitis involving the colonic mucosa in areas of diverticulosis. Because the presence of diverticula appears necessary for the development of the above entities, the term *diverticular colitis* seems most appropriate. However, it must be conceded that the status of this entity remains uncertain. It is unknown whether all patients with SUDD have such inflammation and whether all instances of chronic diverticulitis and SCAD (or diverticular colitis) originate in an episode of acute diverticulitis, either overt or silent. These are issues that only large-scale prospective studies can address.

The medical literature continues to confuse terminology involving diverticulosis. Strate and colleagues proposed a nomenclature that attempts to standardize diverticular terminology and provide evolutionary linkages among the various entities.[42] We present a modification of that scheme, which attempts to accommodate some of the most recent views of diverticulosis (Figure). It must be stressed that some of these linkages are tentative; for example, not all individuals with SCAD have experienced a prior episode of diverticulitis, and the relationship between SUDD and IBS is unclear.

The Role of Colonoscopy After an Attack of Acute Diverticulitis

In light of CT imaging similarities between acute diverticulitis and carcinoma of the colon, colonoscopy has been recommended after an episode of acute diverticulitis to exclude an underlying colon cancer. This approach has been supported by the American College of Gastroenterology, as well as the Society for Surgery of the Alimentary Tract.[55,56] These recommendations, however, have recently been questioned and the issue revisited in the studies described below.

A retrospective longitudinal study from New Zealand followed 292 patients who met the CT criteria for uncomplicated acute diverticulitis; 205 patients underwent a subsequent colonic evaluation or had undergone colonoscopy or CT enterography within the preceding 2 years. Eleven patients (5.4%) were found to have advanced neoplasia (adenoma >10 mm, tubulovillous adenomas, high-grade dysplasia), and only 1 patient (0.5%) had colorectal cancer.[57] In contrast, a retrospective cohort study of 1088 patients with CT-diagnosed acute diverticulitis from Western Australia found an overall prevalence of colorectal cancer of 2.1% within 1 year of CT. The odds of cancer increased almost 7-fold (95% CI, 2.4-18.7) in patients with an abscess, 4-fold (95% CI, 1.1-14.9) in those with a local perforation, and 18-fold (95% CI, 5.1-63.7) in those with a fistula, when compared with patients with uncomplicated diverticulitis. The authors recommended the routine performance of colonoscopy after an episode of acute left-sided diverticulitis in patients who had not undergone a recent colonoscopic evaluation.[58]

In a systematic review of 771 patients from 10 studies, Sai and colleagues defined a similar pooled prevalence of 2.1% (95% CI, 1.2%-3.2%) within 24 weeks of an episode of acute diverticulitis.[59] However, when the authors compared this rate to a calculated estimated prevalence of 0.68% among US adults older than 55 years, the authors concluded that the pooled prevalence of colorectal cancer among those who had experienced an episode of acute diverticulitis was only slightly higher than that expected in comparable subjects in the general population. Another study found that cancers were most likely to be uncovered in patients with an abscess at initial presentation.[60]

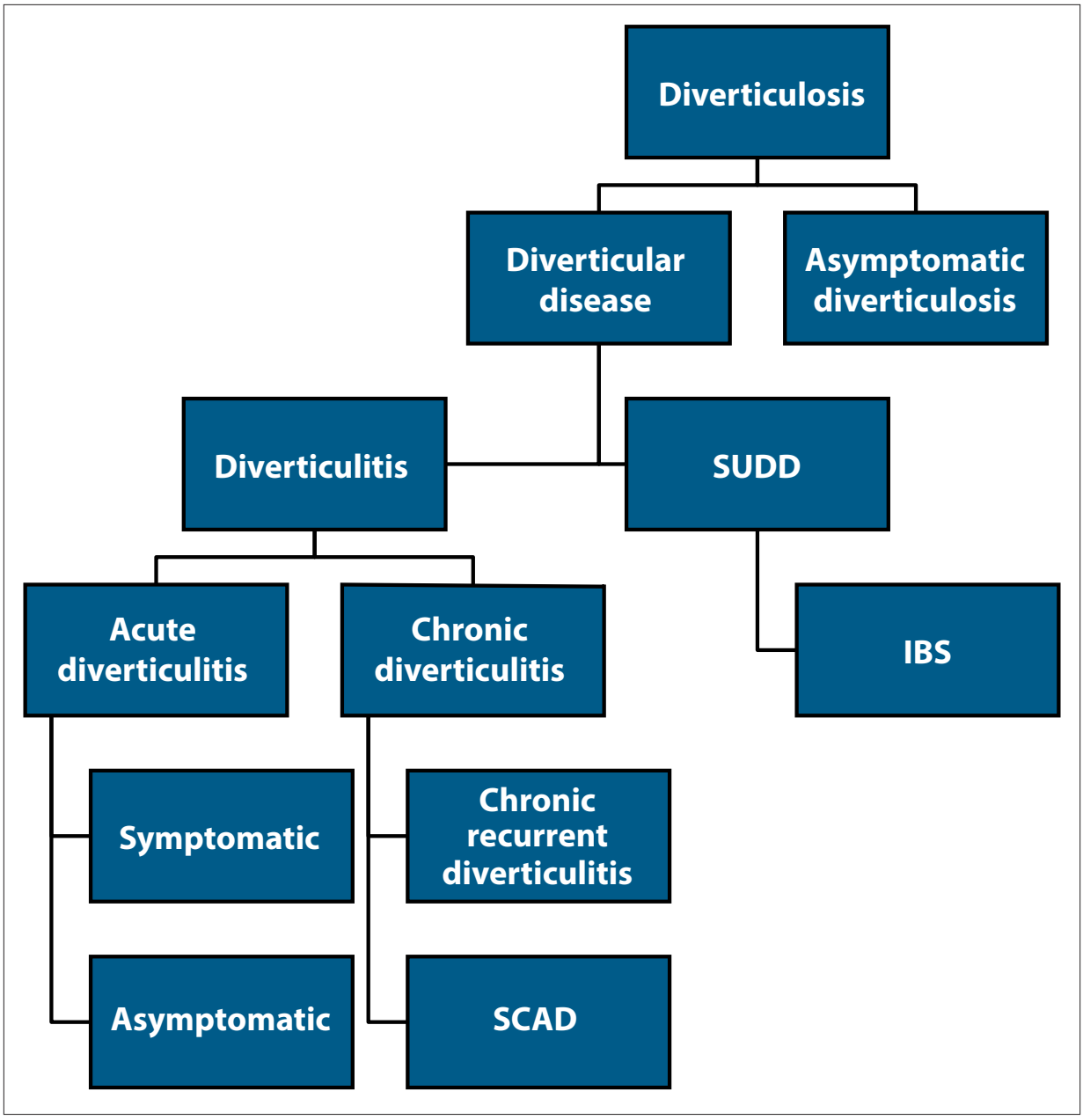

Figure. Classification of the various clinical entities that may evolve from diverticula, showing the possible clinical relationships.

IBS, irritable bowel syndrome; SCAD, segmental colitis associated with diverticulosis; SUDD, symptomatic uncomplicated diverticular disease.

In a comprehensive systematic review and meta-analysis of the role of routine colonoscopy after CT diagnosis of acute diverticulitis, Sharma and colleagues identified 11 studies from 7 different countries.[61] Among 1970 patients who underwent colonic evaluation, cancer was found in only 22 patients, or 1.12%. Eight of these studies reported findings on uncomplicated diverticulitis; in this subgroup, which contained 1497 patients, colorectal cancer was found in only 5, or 0.3%. In contrast, among patients with complicated disease (where this was reported), 6 colorectal cancers were found, a crude rate of 7.6% for finding a malignancy. The overall risk of finding a malignancy with routine colonoscopy after an episode of acute diverticulitis in all patients was 1.6% (95% CI, 0.9%-2.8%). When stratified according to the initial severity of disease, patients with complicated diverticulitis (abscess, fistula, obstruction) still had a high yield of malignancy (10.8%) at subsequent colonoscopy; however, patients with CT diagnosis of uncomplicated diverticulitis had a low yield (0.7%).[61] This and other studies[62,63] suggest that the risk

of colorectal cancer after a CT diagnosis of uncomplicated diverticulitis is so similar to that of the general population that routine colonoscopy is not justified in the absence of other indications. Patients with complicated diverticulitis, however, still appear to have a significant risk of colon cancer at subsequent colonoscopic evaluation.

The overall message in the above studies is that a high-quality CT examination is mandatory at the time of initial presentation, as it allows for adequate identification of patients with uncomplicated diverticulitis. In this particular group, routine colonoscopy is not necessary to exclude malignancy, as the risk for colorectal cancer is the same or only slightly greater than that of an average-risk population. In patients with complicated diverticulitis, however, colonoscopy is indicated, as the risk of an underlying malignancy is significant.

Conclusion

The replacement of time-honored concepts with evidence-based guidelines is always challenging and met with resistance. It is evident that many of the long-held beliefs and classic teachings on diverticulitis and diverticula are not supported by recent research. Dietary fiber is no longer recognized as protective against the development of diverticula, although it may lower the risk of diverticular disease. Nuts, seeds, corn, and popcorn are not responsible for episodes of acute diverticulitis and may, in fact, protect patients from the development of complications. For an individual with diverticula, the risk of an acute episode of diverticulitis is much lower than previously predicted, and recurrent attacks are generally less severe than the initial attack; thus, surgery is no longer routinely recommended after a second attack of uncomplicated diverticulitis. The decision to operate on patients with acute diverticulitis should be made on a case-by-case basis. Antibiotics are not always necessary for the management of acute uncomplicated diverticulitis. Although data are less consistent in this area, diverticulosis has been shown, in certain circumstances, to be associated with chronic abdominal symptoms, with or without underlying chronic inflammatory changes in the involved segment of the colon. Colonoscopy is not routinely necessary after an attack of acute uncomplicated diverticulitis, as the risk of cancer in this population is no higher than that of the general population. However, colonoscopy may still be indicated in cases of complicated diverticulitis, where the imaging of the involved colon is less than ideal in the acute phase. In this situation, colonoscopy should be performed electively, after the acute phase has resolved.

As physicians survey these recent and dramatic changes in the understanding of diverticulosis and its related entities, it is clear that there is still much to learn regarding the exact nature and pathogenesis of this condition, how to predict the risk of future complications, and how to best manage each patient at the time of his or her first presentation. Constant vigilance and a willingness to review and revise the approach to managing diverticulosis and diverticulitis are required so that physicians can provide optimal care for their patients.

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