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Chapter | 1

**Review of current classifications for diverticular disease
and a translation into clinical practice**

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Submitted

Abstract

Diverticular disease of the sigmoid colon prevails in Western society. Its presentation may vary greatly per individual patient, from symptomatic diverticulosis to perforated diverticulitis. Since publication of the original Hinchey classification, several modifications and new grading systems have been developed. Yet, new insights in the natural history of the disease, the emergence of the CT-scan and new treatment modalities plead for evolving classifications. This article reviews all current classifications for diverticular disease. A three stage model is advanced for a renewed and comprehensive classification system for diverticular disease, incorporating up-to-date imaging and treatment modalities.

Introduction

Diverticular disease of the sigmoid colon is a common condition in Western society. The clinical spectrum varies from symptomatic diverticulosis to perforated diverticulitis. The incidence of diverticulosis is 33-66%; of these patients, 10-25% will develop an acute episode of diverticulitis.¹ Although diverticular disease is more common among elderly patients, a dramatic rise of its incidence has been observed at younger age.² Diagnostics, indications for surgery as well as treatment modalities are changing continuously, resulting in a wide array of options.

Since Hinchey's traditional classification for perforated diverticulitis in 1978, several modifications and new classifying systems have been introduced.³ Unfortunately, these different classifications of diverticular disease have led to the publication of confusing evidence. Moreover, none of the classifications sufficiently covers the entire spectrum of the disease. This calls for a thorough review and a new classification.

The current classifications of diverticular disease are based on clinical, radiological or operative findings, yet most lack a translation into daily clinical practice. Given a useful classification system ought to guide clinical decision making and management, this review serves to combine the available classifications with current knowledge and proposes a more practical approach for treating diverticular disease.

Methods

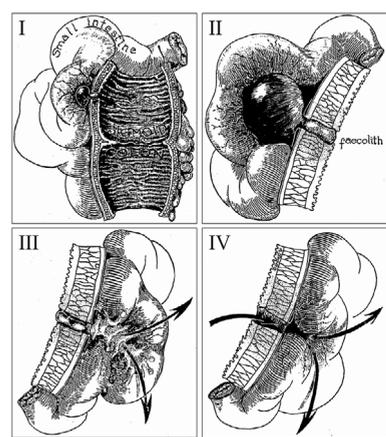
The literature study revealed a total of nine classifications and modified classifications for diverticular disease. A PubMed search was done, using the following 'MeSH' terms: [diverticulitis], [classification] and [colonic diverticulosis], revealing only a few classifications for diverticular disease. In most publications the results of a clinical study on imaging or treatment modalities are described, and rarely the proposal of a new classification system. A second analysis using manual cross reference search of the bibliographies of relevant articles located studies not found in the first search. The third strategy used the 'related article' function in PubMed to select articles not found in above searches. All articles in English, German and Dutch have been included.

Classifications

A useful classification system is indispensable for treating a disease with so many manifestations and even more treatment modalities. Of course devising a classification system is not a goal in itself, this activity should always have a practical purpose. Properly practical systems can improve mutual communication between doctors of different specialties and support clinical decision making as well as management. Even more important, they enable the clinician to improve on predicting outcomes, stratifying risks, assessing conditions, and diagnosing diseases more accurately.

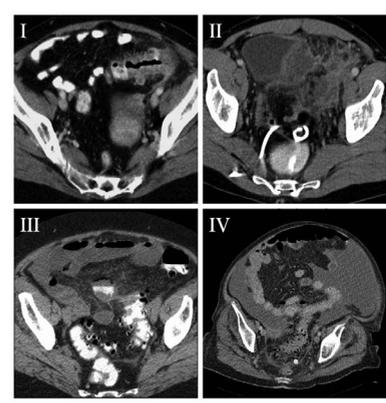
In 1978 Hinchey et al. published their classification for acute diverticulitis.³ The Hinchey classification has traditionally been used to distinguish four stages of perforated disease (see Table 1). This most widely used classification was actually based on an earlier clinical characterisation of acute diverticulitis published by Hughes et al. in 1963 (see Figure 1).⁴

Figure 1 Hughes classification



Hughes ESR et al. The surgical management of acute diverticulitis. MJA 1963; 50 (1): 780-782. © Copyright 1963. The Medical Journal of Australia - reproduced with permission

Figure 2 CT-scan images



I Pericolic phlegmon with small associated abscess
 II Large intraabdominal abscess
 III Small amounts of free air and fluid
 IV Massive pneumoperitoneum and free fluid

classification, with subcategories (see Figure 2). In 1997 Sher et al. introduced the first modification of Hinchey's classification, distinguishing pericolic abscesses (stage I) from distant abscesses amenable for percutaneous drainage (stage IIa) and complex abscesses associated with a possible fistula (stage IIb).⁵ This modification included the use CT-guided percutaneous drainage of abscesses (see Table 1).

Table 1 Hinchey classification and modified Hinchey classification by Sher et al.

Hinchey classification ³		Modified Hinchey classification by Sher et al. ⁵	
I	Pericolic abscess or phlegmon	I	Pericolic abscess
II	Pelvic, intraabdominal or retroperitoneal abscess	IIa	Distant abscess amenable to percutaneous drainage
		IIb	Complex abscess associated with fistula
III	Generalized purulent peritonitis	III	Generalized purulent peritonitis
IV	Generalized fecal peritonitis	IV	Fecal peritonitis

In 1999, Wasvary et al. published the next modification, which since then has been widely adopted (see Table 2).⁶ This modification broadened the original Hinchey classification by not only addressing perforated disease, but also including mild clinical disease (stage 0). Additionally, a difference was made between confined pericolic inflammation or phlegmon (stage Ia) and a confined pericolic abscess (stage Ib).

Also in 1999, Köhler et al. published a consensus statement by the European Association of Endoscopic Surgeons (EAES), entailing a clinical classification that differentiated symptomatic uncomplicated disease, recurrent symptomatic disease and complicated disease (see Table 3).⁸

In German literature since 1998, the Hansen/Stock classification has been mainly used. This is also a clinical classification accounting for asymptomatic diverticulosis as well as complicated diverticulitis in different stages, depending on the severity of the complications (see Table 4).⁹ These aspects make it probably the most useful classification for diverticular disease; however, it has rarely been adopted in international literature. Another German classification published in 1995 by Siewert et al. followed a similar delineation for complicated disease.¹⁰

The introduction of computed tomography (CT) in the 1980's, improved preoperative assessment of diverticular disease and allowed modifications of the original Hinchey

Table 2 Modified Hinchey classification by Wasvary et al. and CT-findings by Kaiser et al.

Modified Hinchey classification by Wasvary et al. ⁶		CT-findings by Kaiser et al. ⁷
0	Mild clinical diverticulitis	Diverticuli ± colonic wall thickening
Ia	Confined pericolic inflammation or phlegmon	Colonic wall thickening with pericolic soft tissue changes
Ib	Pericolic or mesocolic abscess	Ia changes + pericolic or mesocolic abscess
II	Pelvic, distant intraabdominal or retroperitoneal abscess	Ia changes + distant abscess (generally deep in the pelvis or interloop regions)
III	Generalized purulent peritonitis	Free gas associated with localized or generalized ascites and possible peritoneal wall thickening
IV	Generalized fecal peritonitis	Same findings as III

Table 3 Classification by Köhler et al.

Classification by Köhler et al. ⁸		
Symptomatic uncomplicated disease		
Recurrent symptomatic disease		
Complicated disease		
<ul style="list-style-type: none"> • Hemorrhage • Abscess • Phlegmon 	<ul style="list-style-type: none"> • Fistula • Perforation • Stricture 	<ul style="list-style-type: none"> • Purulent and fecal peritonitis • Small bowel obstruction due to postinflammatory adhesions

In conclusion, this review of current literature on diverticular disease shows that the differences and similarities between classifications are far from clear. Moreover these classifications appear to be used at random and are incomprehensible for practical use. Clinical questions as: Where does the recurrent diverticular bleeding belong? And where do we put post-inflammatory stenosis? cannot be reliably answered when using these existing classifications.

Table 4 Hansen/Stock and Siewert classification

Hansen/Stock classification ⁹		Siewert et al. ¹⁰	
0	Diverticulosis		
I	Acute uncomplicated diverticulitis		
II	Acute complicated diverticulitis		
a	Phlegmon, peridiverticulitis	I	Pericolic abscess or phlegmon
b	Abscess, sealed perforation	II	Pelvic, intraabdominal or retroperitoneal abscess
c	Free perforation	III	Free perforation
III	Chronic recurrent diverticulitis		

Clinical presentation

As stated above, Köhler et al. presented a more clinical classification for diverticular disease. Although symptoms are difficult to grade, crampy pain, fever, and changes in relief pattern are considered to be symptomatic. It has to be noted that a large number of patients with pain in the left lower quadrant, fever and soiling are probably never referred to a hospital, consulting only primary care. Such mild symptoms are often self-limiting or treated with antibiotics by a general practitioner.

Clinical episodes are characterized by focus on more objective signs, like raised infectious parameters in laboratory tests and typical findings on CT-scan or colonoscopy.¹ But this does not discount the initial, subjective complaints. For instance, in cases where the first clue for a stenosis might be impaired passage of stool, or that diverticular bleeding is the most common cause recurrent rectal blood loss, or that pneumaturia is pathognomic for a colovesical fistula. Clinical examination of patients having such subjective complaints none the less is crucial for arriving at a diagnosis. Therefore, the diagnosis of a generalized peritonitis remains a clinical diagnosis, nowadays often confirmed by CT-scan, and forms an absolute indication for surgery.

Recently, various articles on the natural course of diverticular disease point out that mild diverticular disease usually follows a benign course, whereas complicated disease first

presents itself at the first episode of the disease.¹¹ These findings suggest using a more conservative approach to mild diverticular disease. Because most of these publications do not account for the growing incidence of diverticular disease among younger patients, including symptoms of being incapacitated by recurrent episodes of mild diverticulitis, perhaps a more aggressive approach might be justified for treating this group.^{2,12}

Imaging

The original Hinchey classification was based on both clinical and surgical findings. Since then new diagnostic tools have been developed. The usual tests performed in the acute phase of diverticular disease are water-soluble contrast enema, CT-scan, and ultrasonography. Although ultrasound has been proven as a non-invasive, readily available tool to diagnose acute diverticulitis, its drawbacks are the dependency on the level of the examiner's competence and the fact that images are difficult to interpret by other physicians.¹³

In today's clinical practice regarding diverticular disease, CT-scans enhanced with intravenous and intrarectal contrast have, because of their superior sensitivity and specificity up to 100%, replaced contrast enemas as the most important imaging modality.^{14,15} CT allows for direct percutaneous drainage of associated abscesses, which renders it a valuable attribute in the treatment of complicated diverticular disease.¹⁶ In the case of diverticular bleeding, a CT-scan enhanced with intravenous contrast (CT-angio) may play a central role; however, in order to demonstrate a contrast blush, blood loss has to be at least two millilitres per minute. When a contrast blush is demonstrated, endovascular coiling may be considered, although 80% of all diverticular bleeding is self-limiting.

A colonoscopy is indicated when there is doubt about the presence of cancer, persisting or recurrent pain in the left lower quadrant, suspicion of a stenosis or recurrent blood loss. Colonoscopy allows taking biopsies for histological diagnosis and control of diverticular bleeding may be attempted by endoscopic measures, such as clipping, coagulation or adrenaline injections.¹⁷ Routine colonoscopy divulges the majority finds of asymptomatic diverticular disease, follow-up colonoscopy is advised six weeks after an episode of acute diverticulitis for ruling out malignancy.

In recent years, Magnetic Resonance Imaging (MRI) has gained popularity, because it lacks the ionizing radiation of a CT-scan yet matches its sensitivity and specificity.¹⁸ Additional advantages of MRI over CT-scan are its better visualization of fistulae and the possibility of virtual colonoscopy, thereby providing an alternative for invasive colonoscopy.

CT-scanning not only initiated modifications to the Hinchey classification, but it gave as well birth to new radiological classifications for diverticular disease. Kaiser et al. have published specific CT-findings per modified Hinchey stage (see Table 2), resulting in a guideline for objective observation and reporting.⁷ The publications on the role of CT-scans in diverticular disease by Ambrosetti et al., divide diverticulitis into severe or moderate disease (see Table 5). In this approach, CT-scans are an indispensable help for the physician in the acute setting, as well as a prognostic factor for the incidence of evolving complications after a first conservatively treated episode.¹⁹

Table 5 CT-findings by Ambrosetti et al.

CT-findings by Ambrosetti et al. ¹⁹	
Moderate diverticulitis	Localized sigmoid wall thickening (< 5 mm)
	Pericolonic fat stranding
Severe diverticulitis	Abscess
	Extraluminal air
	Extraluminal contrast

Treatment

Moderate cases of diverticular disease, such as phlegmon or small abscesses, can be treated conservatively. Initial prescriptions are often oral antibiotics and a fluid diet, followed by preventive measures like a high-fibre diet, prevention of obesity and treatment of comorbidities.²⁰⁻²² Newer insights into the pathophysiology of diverticular disease, comparable to inflammatory bowel disease, has led to research on the use of 5-aminosalicylic acid (Mesalazine) and probiotics as adjunctive treatments for diverticular disease.^{23,24}

Large abscesses, if amenable and usually larger than five centimetres, should be good candidates for CT-guided percutaneous drainage.²⁵ This procedure may relieve all symptoms or function as a bridge to (elective) surgery.

Purulent or faecal peritonitis resulting from perforation is associated with high morbidity and mortality (10-35%).²⁶ Under these severe circumstances, acute surgical intervention is warranted. Hartmann's procedure used to be the treatment of choice, but resection followed by primary anastomosis or laparoscopic lavage are increasingly used.^{27,28}

In order to prevent complicated disease after two episodes of acute diverticulitis, it has for years been considered good practice to perform elective sigmoid resection even after one episode in younger patients.²⁹ These recommendations by the American Society of Colorectal Surgeons (ASCRS) in 2000, have recently been challenged. It is now thought that after an episode of conservatively treatment, diverticular disease could follow a rather benign course and that complications occur mostly at first presentation.^{11,30,31} Therefore, elective sigmoid resections should be restricted for use in treating complicated disease, such as symptomatic stenosis, fistulas to a hollow organ or recurrent diverticular bleeding. Furthermore, recent publications on the natural course of diverticular disease suggest applying early elective sigmoid resection in high-risk patients, such as young patients, or with immune compromised patients, or patients using NSAIDs and other immune suppressants or those with chronic renal failure.³²

Since the mid 1990s, laparoscopic sigmoid resections for diverticular disease have gained popularity. Several retrospective series of laparoscopic sigmoid resections suggested improvements in minor complication rates, earlier resumption of oral food intake and shorter hospital stay.³³⁻³⁵ It lasted until January 2009 before a randomized controlled trial confirmed these beneficial effects.³⁶ The short-term results of the Sigma-trial showed that a laparoscopic approach delivered a significant 15.4% reduction in major morbidity, less pain, shorter hospitalization and improved quality of life at the cost of a longer operating time. For use of elective sigmoid resections in patients with diverticular disease, these should therefore preferably be approached laparoscopically, but only in experienced hands.

Discussion and a proposal of a new classification

This review of the current classification systems for a condition as complex as diverticular disease raises the question: Is there a need for another classification? We acknowledge that the introduction of yet another classification could be even more confusing. Consequently, the aim of this review is not to add another modification or new classification, but to combine the existing classifications and make a comprehensive translation of the findings for use in daily clinical practice. By doing so, new imaging and treatment modalities are to be incorporated.

We propose three stages of differentiating diverticular disease: A) Uncomplicated; B) Moderately complicated; C) Severely complicated (see Table 6). We thereby address clinical findings ('Presentation'), radiological findings ('Imaging') and treatment modalities ('Treatment') in different paragraphs. This stepwise approach resembles clinical decision making and forms the basis for a practice parameter on diverticular disease (see Table 6).

The three stages A, B, and C resemble the clinical classification as devised by Köhler et al. and the German Hansen/Stock classification. One difference is that because indications for elective resection no longer depend on the number of episodes, there is no further need to distinguish between 'symptomatic uncomplicated disease' and 'recurrent symptomatic disease'. Furthermore the category of 'complicated disease' found in Köhler et al. covers all possible complications of diverticular disease, both moderate and severe, and hence may be confusing. Each stage is now described separately.

The original Hinchey classification for perforated diverticulitis and its modifications are mainly represented in stage C. Large abscesses (C1) and perforated disease (C4) are severe complications, but also massive diverticular (C3) bleeding and total bowel obstruction (C2) are entitled to acute interventions. Abscesses, if amenable should be drained percutaneously under CT-guidance. Massive diverticular bleeding can be approached endoscopically (clipping, coagulation or adrenaline injections) or endovascularly (coiling), but in most cases a (laparoscopic) sigmoid resection is the final solution. When generalized peritonitis is suspected and CT shows signs of perforation, diagnostic laparoscopy needs to be considered. In case of purulent peritonitis, either (laparoscopic) sigmoid resection with primary anastomosis or laparoscopic lavage may be considered when bowel distension is absent. When fecal material is discovered, a Hartmann's procedure should be performed.

Table 6 Proposed classification

Classification	Presentation	Imaging	Treatment
A	Uncomplicated disease		Conservative treatment
	<ul style="list-style-type: none"> • Pain in left lower quadrant • Fever • Changes in bowel habits 	CT-scan <ul style="list-style-type: none"> • Phlegmon • Small abscess in bowel wall Colonoscopy <ul style="list-style-type: none"> • Diverticulosis • Inflammation 	Treatment acute episode <ul style="list-style-type: none"> • Antibiotics • Low residue diet Prevention <ul style="list-style-type: none"> • Fibers • Prevention of obesity • Treatment of comorbidity • Mesalazine
B	Moderately complicated disease		Elective intervention
	<ul style="list-style-type: none"> • Impaired passage of stool • Presence of fistula • Recurrent rectal blood loss • Incapacitating symptoms • High-risk patients 	CT-scan <ul style="list-style-type: none"> • Stenosis • Fistula Colonoscopy <ul style="list-style-type: none"> • Stenosis • Fistula • Blood in diverticula 	Sigmoid resection with primary anastomosis <ul style="list-style-type: none"> • Open • Laparoscopically
C	Severely complicated disease		Acute intervention
1	<ul style="list-style-type: none"> • Fever • Painful mass 	CT-scan <ul style="list-style-type: none"> • Large abscesses (> 5 cm) 	Percutaneous drainage
2	<ul style="list-style-type: none"> • Ileus 	CT-scan <ul style="list-style-type: none"> • Intestinal obstruction 	Sigmoid resection with primary anastomosis Hartmann's procedure
3	<ul style="list-style-type: none"> • Massive rectal blood loss 	CT-angio <ul style="list-style-type: none"> • Contrast blush Colonoscopy <ul style="list-style-type: none"> • Active diverticular bleeding 	Sigmoid resection with primary anastomosis <ul style="list-style-type: none"> • Open • Laparoscopically Endoscopic intervention Endovascular coiling
4	<ul style="list-style-type: none"> • Generalized peritonitis 	CT-scan <ul style="list-style-type: none"> • Pneumoperitoneum • Extraluminal contrast • Free fluid 	Diagnostic laparotomy / laparoscopy <ul style="list-style-type: none"> • Resection with primary anastomosis • Lavage and drainage • Hartmann's procedure

In most classifications, post-inflammatory changes such as stenosis or fistulas are not included. Stage B includes late complications of diverticular disease, such as symptomatic stenosis, fistulas to hollow organ, recurrent (self-limiting) diverticular bleeding and incapacitating symptoms. This last group of patients includes many young patients who are incapacitated by recurrent attacks and hospital admissions, which prevent them from having normal careers and social life. In addition, high-risk patients, such as those who are immune compromised, using NSAIDs or other immune suppressants and those with chronic renal failure, are good candidates for early elective sigmoid resection. Colonoscopy has to be performed in these cases to rule out other causes of intermittent rectal blood loss. Stage B disease requires elective sigmoid resections, and if sufficient experience is available, these should be performed out laparoscopically.

Stage A includes those with symptomatic uncomplicated disease. Patients with mild symptoms treated by primary care or recurrent hospital admission should not be considered differently, because both groups will fully recover with conservative measures. Acute episodes of stage A diverticulitis can mostly be resolved with antibiotics and a low residue diet. Recurrent episodes usually follow a benign course and risks of complications are low. At presentation, a CT-scan has to be performed to rule out complicated disease. These baseline findings are crucial if the patient deteriorates during conservative treatment. Small amounts of mucus or blood loss are generic signs of inflammation, whereby colonoscopy has to rule out other inflammatory bowel diseases or colon cancer. After a first attack, preventive measures have to be taken into account, such as high-fibre diet, weight loss and treatment of comorbid conditions. Also, the prescription of Mesalazine can be considered.

In conclusion, this manuscript provides an overview of current classification systems for diverticular disease. The proposed three stage model provides a renewed and comprehensive classification system for diverticular disease, incorporating up-to-date imaging and treatment modalities.

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