Colonic diverticulitis: diagnostic value and appearance of inflamed diverticula—sonographic evaluation

Abstract Acute bowel inflammation frequently originates from thin-walled diverticula of the colon. Not the presence of diverticula, but the demonstration of an inflamed diverticulum, is diagnostic of diverticulitis in cases of bowel wall thickening and pericolonic inflammation. The aim of this study was to investigate the sonographic appearance and detectability of inflamed diverticula. One hundred seventy-five consecutive patients with clinically suspected diverticulitis underwent sonographic examination. Outpouchings from the colonic wall centred in the pericolonic inflammation were considered inflamed diverticula. Depending on the sonographic appearance they were divided into four groups: hypoechoic; predominantly hyperechoic; hyperechoic with surrounding hypoechoic rim; and hyperechoic with acoustic shadowing. Sonography showed inflamed diverticula in 79 (77%) of 102 patients with diverticulitis. Inflamed diverticula were hypoechoic in 37%, predominantly hyperechoic in 4%, hyperechoic with surrounding hypoechoic rim in 41% and hyperechoic with acoustic shadowing in 18% of patients. In 23 (23%) of 102 patients no inflamed diverticulum was demonstrable. This group included 17 patients with complicated diverticulitis and 6 false-negative cases. An inflamed diverticulum as a sign of diverticulitis yielded an overall sensitivity of 77% and a specificity of 99%. Sensitivity in uncomplicated disease was 96%. In patients with uncomplicated diverticulitis an inflamed diverticulum is a sign of diverticulitis with excellent sensitivity and specificity, usually with solitary and less frequently with more than one inflamed diverticulum being demonstrable. In patients with complicated diverticulitis an inflamed diverticulum is often not detectable.

Keywords Colonic diseases · Diverticulosis · Diverticulitis · Inflamed diverticulum · Ultrasound

Introduction

Colonic mural thickening, pericolonic inflammation and at times the visualization of diverticula are the most common criteria used for the sonographic diagnosis of diverticulitis [1, 2, 3, 4, 5]. Especially when diverticulitis is diagnosed upon mural thickening and pericolonic inflammation, other diseases with a similar sonographic appearance must be differentiated such as Crohn’s disease, penetrating colonic cancer, ischaemic colitis and other colonic and pericolonic inflammatory conditions [6, 7, 8]. Segmental bowel wall thickening, inflammatory changes of the pericolonic fat and even the presence of diverticula are consistent with but not diagnostic of acute diverticulitis [9]. To differentiate diverticulitis from other diseases upon sonographic appearance, further sonographic criteria are required.

Diverticulitis primarily results from obstruction of the orifice of a diverticulum, leading to localized inflammation and to a microperforation in almost all cases.
[8, 10]. Subsequently, localized peridiverticular inflammation, a pericolic abscess and less commonly a fistula to a nearby organ or generalized peritonitis may occur [8, 10]. An inflamed diverticulum is characterized by its localization in the centre of the pericolic inflammation. In their article, Wada et al. report that the main sonographic finding in uncomplicated diverticulitis of the cecum and ascending colon is a focus of variable echogenicity protruding from a segmentally thickened colonic wall [11]. More recent CT studies describe inflamed diverticula of right-sided and less frequently of left-sided diverticulitis [9, 12, 13]. Sonographic studies referring to left-sided diverticulitis occasionally describe inflamed diverticula as hyperechoic, shadowing outpouchings of the thickened colon, whereas we observed a variety of sonographic appearances. Most of these studies do not clearly differentiate between uninfamed and inflamed diverticula [8, 14].

To the best of our knowledge, the value of an inflamed diverticulum as a sign of diverticulitis has not been assessed in previous studies. We therefore investigated the sonographic appearance and the frequency of visualization of inflamed diverticula in patients with clinically suspected colonic diverticulitis.

![Image](image_url)

**Fig. 1** Diverticulosis in 72-year-old woman. Transverse sonogram of the sigmoid colon shows hyperechoic outpouchings (arrows) of the colonic wall (arrowheads) representing normal diverticula and sonography as the initial imaging method. If patients had mid-lower abdominal pain and transabdominal sonography was negative or inconclusive, additional transrectal sonography was performed for evaluation of the lower sigmoid colon [15].

Transabdominal sonograms were obtained with 2- to 4-MHz convex and 4- to 7-MHz or 5- to 10-MHz linear multifrequency transducers on commercially available equipment (HDI 3000, Advanced Technology Laboratories, Bothell, Wash.). Patients were scanned without any preparation using the graded compression technique [16]. Whenever possible, a high-frequency transducer was used for obtaining more detailed information on the pathological condition. For transrectal sonography we used a multifrequency 5- to 9-MHz end-firing endocavitary probe (HDI 3000, ATL). Sonographic examinations were performed by one of four radiologists experienced in gastrointestinal sonography. All CT studies were performed on a helical scanner (X-Vision, Toshiba Medical Systems, Tokyo, Japan).

The examinations performed in the 175 patients included sonography (all cases), CT scans (57 cases), colonoscopies (48 cases, of which 21 cases included biopsies) and contrast enemas (27 cases). Final diagnosis was based on either histological reports of the surgical specimens (39 cases) or in patients with conservative treatment on a consensus opinion of the referring clinician and the radiologist. The consensus opinion was based on clinical data, laboratory parameters and results of imaging methods performed. In all patients with conservative treatment (n = 136) sonographic and clinical follow-up was available. Patients with diverticulitis who did not have colonoscopy or contrast enema in the initial evaluation usually underwent colonoscopy after a 4-week interval in order to exclude colonic cancer.

**Control group**

A control group of 40 patients (19 women and 21 men; age range 48–90 years, mean age 69 years) without any clinical signs of diverticulitis underwent sonography for evaluation of the sonographic appearance of normal diverticula. Thirty-five patients had transabdominal and 5 patients had transrectal sonography. Examinations of the lower sigmoid colon for diverticulosis were performed in the course of the transrectal sonographic examination for prostatic disease. Informed consent was obtained from each patient. The control subjects fasted overnight but were not especially prepared for the sonographic examination.

The only selection criteria for control subjects were detectable diverticula by means of sonography and absence of abdominal pain or other clinical and laboratory parameters indicative of diverticulitis. The sonographic signs that were investigated in the 40 control subjects were (a) the echogenicity of diverticula, and (b) the presence or absence of pericolic inflammation. Normal diverticula presented as rounded or oval outpouchings of the colonic wall. All normal diverticula were hyperechoic, and if a peripheral hypoechoic rim was present, it was very thin (< 1 mm; Fig. 1). Some of the diverticula showed clean acoustic shadowing because of an intraluminal fecalith. None of the control subjects had signs of pericolic inflammation.

**Patients and methods**

**Patient population and imaging technique**

From January 1998 to May 2000 all of the 175 consecutive patients with clinically suspected diverticulitis were referred to the radiology department of our hospital for sonographic examination. The study group consisted of 109 women and 66 men, aged 15–89 years (mean age 61 years). All patients underwent transabdominal