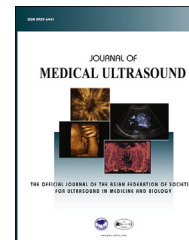


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ORIGINAL ARTICLE

Right-Sided Colonic Diverticulitis: Clinical Features, Sonographic Appearances, and Management



Tse-Cheng Chiu¹, Yi-Hong Chou^{1,2*}, Chui-Mei Tiu^{1,2},
Hong-Jen Chiou^{1,2}, Hsin-Kai Wang^{1,2}, Yi-Chen Lai¹,
Yi-You Chiou^{1,2}

¹ Department of Radiology, Taipei Veteran General Hospital, National Yang Ming University, and
² School of Medicine, National Yang Ming University, Taipei City, Taiwan, ROC

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KEYWORDS

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Abstract *Purpose:* This study aims to evaluate patients with right-sided colonic diverticulitis detected at ultrasonography (US).

Methods: We retrospectively analyzed 14 patients. Demographic data, clinical features, and US images were documented.

Results: In the 14 patients, clinical manifestations included right lower abdominal tenderness (93%), leukocytosis (57.1%), and fever (28.6%). Diverticulitis occurred in cecum and ascending colon with a similar frequency (35.7%). US features included diverticular wall thickening (50%), surrounding echogenic fat (50%), intradiverticular echogenic material (50%), adjacent lymph node enlargement (21.4%), intradiverticular or peridiverticular fluid collection (28.6%), and color flow signals on or surrounding the diverticula (14.3%). Two (14.2%) patients suffered from recurrence. Two (14.3%) patients had abscess formation, and one (7.1%) patient had diverticulum perforation. Most (85.7%) patients received conservative treatment only. One (7.1%) patient received computed tomography-guided drainage due to diverticulum perforation and pocket of abscess formation. One patient underwent surgery due to recurrent diverticulitis-related fistula.

Conclusion: Common US features of diverticulitis include diverticular wall thickening, surrounding echogenic fat, and intradiverticular echogenic material. Proper recognizing of these features helps in differentiating diverticulitis from appendicitis and may obviate an unnecessary emergent surgery.

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Conflicts of interest: The authors have no conflicts of interest to declare.

* Correspondence to: Dr Yi-Hong Chou, Department of Radiology and Occupational Safety and Health Office, Taipei Veteran General Hospital, Number 201, Sector 2, Shipai Road, Beitou District, Taipei City 11217, Taiwan, ROC.

E-mail address: yhchou@vghtpe.gov.tw (Y.-H. Chou).

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Introduction

Colonic diverticulitis is a common condition affecting the adult population. Traditionally, the sigmoid colon is considered the most commonly involved part, and right-sided diverticulitis is much rarer [1]. However, in the Asian countries, right-sided diverticulitis outnumbers the left [2]. The right-sided diverticulitis differs from the left-sided diverticulitis in many aspects. The former is usually congenital and solitary [3,4]. Most importantly, the right-sided diverticulitis often resembles the acute appendicitis in clinical presentation. Therefore, image studies are mandatory to make a correct diagnosis [2,5]. Computed tomography (CT) is generally accepted as an imaging of choice in the diagnosis of colonic diverticulitis [6]. However, ultrasonography (US) is more economic than CT and poses no radiation, which is particularly important since the patients having right-sided diverticulitis are relatively younger [4] and are thus more susceptible to radiation-induced malignancy [7]. The US appearance of right-sided diverticulitis is less well documented. This study focused on the demographic data, US appearances, and treatment outcomes of right-sided colonic diverticulitis based on the review of 14 patients.

Material and methods

The study was conducted in a tertiary medical center in Taiwan. It has about 3000 beds in service. We retrospectively searched the sonography report archive from March 2007 to March 2014. Reports containing the keyword "diverticulitis" were selected. The medical records were reviewed. Of these, 14 US-diagnosed or suspected of right-sided diverticulitis were included for analysis. Among them, 10 patients had CT scans as confirmation. Demographic data including age, sex, comorbidity, and clinical features, such as fever, leukocytosis, inflammatory marker, tenderness, lesion location, nausea/vomiting, diarrhea/constipation, treatment, complication, and time to recurrence were documented. The mean age along with standard deviation and distribution of other demographic and clinical features were analyzed. The US images of each patient and available CT images were reviewed and categorized based upon their image features.

Results

In total, 14 (8 male and 6 female) patients, with a mean age of 52.1 years, were analyzed. The demographic information is shown in Table 1. Comorbidities including history of diverticulosis, appendectomy, and other chronic systemic disease are also listed in Table 1. The clinical features and presentations are shown in Table 2. The most common presentations are right lower quadrant abdominal pain (92.9%), leukocytosis (57.1%), and fever (28.6%). Diverticulitis developed in cecum and ascending colon with a similar frequency (35.7%, 5/14). In 28.6% of the cases, the lesion sites cannot be distinguished between the two.

Among the 14 patients, six major sonographic findings were observed (Table 3). The most common features are

Table 1 Demographic data of 14 patients with right-sided diverticulitis.

Patient characteristics	% (n)
Mean age (y)	52.1 (31–81, SD = 17.5)
Sex	M = 8 F = 6
Comorbidity	
None	42.9 (6)
Post appendectomy	28.6 (4)
Known history of diverticulosis	7.1 (1)
Diabetes mellitus	21.4 (3)
COPD	7.1 (1)
Hypertension	28.6 (4)
Peptic ulcer	14.3 (2)
ESRD	7.1 (1)
Hydronephrosis	7.1 (1)
Aortic aneurysm	7.1 (1)
Asthma	7.1 (1)
Post myomectomy	7.1 (1)

COPD = chronic obstructive pulmonary disease; ESRD = end-stage renal disease; F = female; M = male; SD = standard deviation.

surrounding echogenic fat (50%) and diverticular wall thickening (50%; Figures 1 and 2), intradiverticular echogenic material (50%; Figures 2–4), followed by enlarged regional lymph node (21.4%; Figure 5).

Two (14.3%) patients suffered from recurrence at 2 months and 19 months, respectively, after the first episode. Two (14.3%) patients had abscess formation, and one (7.1%)

Table 2 Clinical features and presentation of the 14 patients.

Presentations	% (n)
Nausea/vomiting	7.1 (1)
Diarrhea	7.1 (1)
Fever	28.6 (4)
Right lower quadrant abdominal pain	92.9 (13)
Leukocytosis	57.1 (8)
Time to ultrasound study (d)	3
Location	
Cecum	35.7 (5)
Ascending colon	35.7 (5)
Indistinguishable between cecum and ascending colon	28.6 (4)
Complication	
Rupture	7.1 (1)
Abscess	14.3 (2)
Treatment	
Conservative treatment only	85.7 (12)
Drainage and conservative treatment	7.1 (1)
Surgery	7.1 (1)
Hospitalization	78.7 (11)
Length of hospital stay (d)	5.9 (4–8)
Recurrence	14.3 (2)
Mean follow-up (mo)	40.7 (10–71)

Table 3 Sonographic features of the 14 patients.

Sonographic features	% (n)
Surrounding echogenic fat	50 (7)
Diverticular wall thickening	50 (7)
Adjacent lymph node enlargement	21.4 (3)
Intradiverticular/peridiverticular fluid collection	14.3 (2)
Increased flow signal on or surrounding the diverticulum	14.3 (2)
Intradiverticular echogenic material	50 (7)

patient had perforation. All but two (86%) patients received conservative treatment only. In one (7.1%) patient, US demonstrated a pocket of fluid accumulation, suggestive of pus. The subsequent CT-guided aspiration confirmed the nature of an abscess (Figure 6). The second patient had recurrent diverticulitis and complicated with colovesical fistula 2 months later. Therefore, this patient received an elective right hemicolectomy.

Discussion

Diverticulitis is the inflammation of the diverticulum. The exact pathogenesis is still unclear [8]. It is thought to be related to several factors including diet, colon microbes, genetic factors, and colonic motility. While rare in the Western population [9], right-sided acute colonic diverticulitis is more prevalent in the Asian population. However, the clinical presentation, diagnosis, and management are less well described in the literature [10].

In our study, the clinical presentations, such as right lower abdominal pain and tenderness (93%), fever (28.6%), and leukocytosis (57.1%), do not allow a confident diagnosis of right-sided diverticulitis, and differentiation between acute appendicitis and diverticulitis is almost impossible. Although some author had purposed several clinical features including prodromal symptoms, location of rebound tenderness, white blood cell differential count to differentiate these two entities [11], the clinical utility remained unclear. In an earlier study, a correct preoperative diagnosis of right-sided diverticulitis was rare and acute

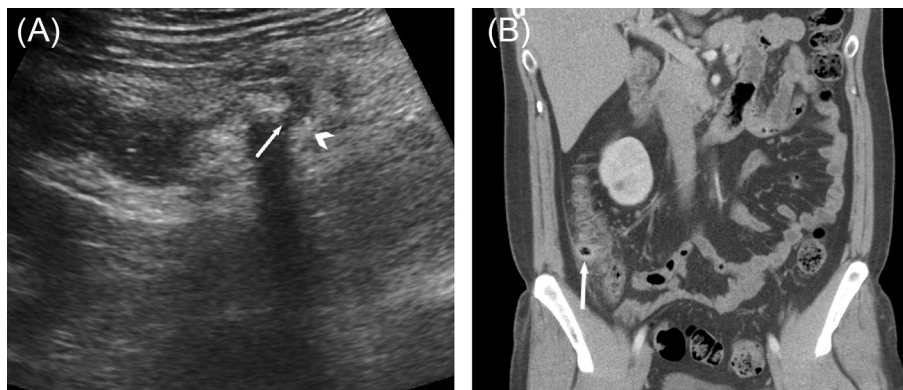


Figure 1 A 63-year-old male patient suffered from right lower abdominal pain for 1 day. (A) Ultrasonography of the right lower abdomen. Longitudinal scan shows a thick-walled diverticulum (arrow) with adjacent echogenic fat (arrowhead); (B) contrast-enhanced computed tomography with coronal reconstruction shows a diverticulum on the ascending colon associated with thick wall and pericolic fat stranding (arrow).

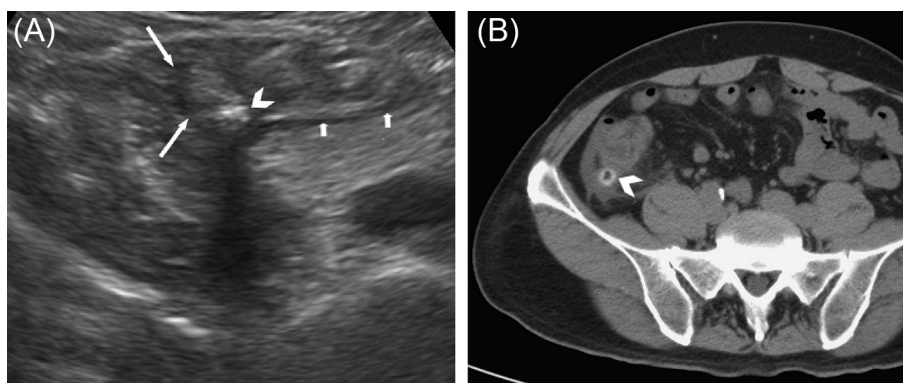


Figure 2 A 53-year-old male patient presented with right lower abdominal pain for 1 day. (A) Ultrasonography shows a protruding out-pouch (arrows) from colonic wall (short arrows), representing a colonic diverticulum. The diverticular wall and the adjacent colonic wall are thickened. The lumen contains an echogenic structure causing acoustic shadows, which is consistent with stone formation (arrowhead); (B) noncontrast computed tomography demonstrates a diverticulum with a hyperdense stone in the lumen (arrowhead), colon wall thickening, and pericolic fat stranding.

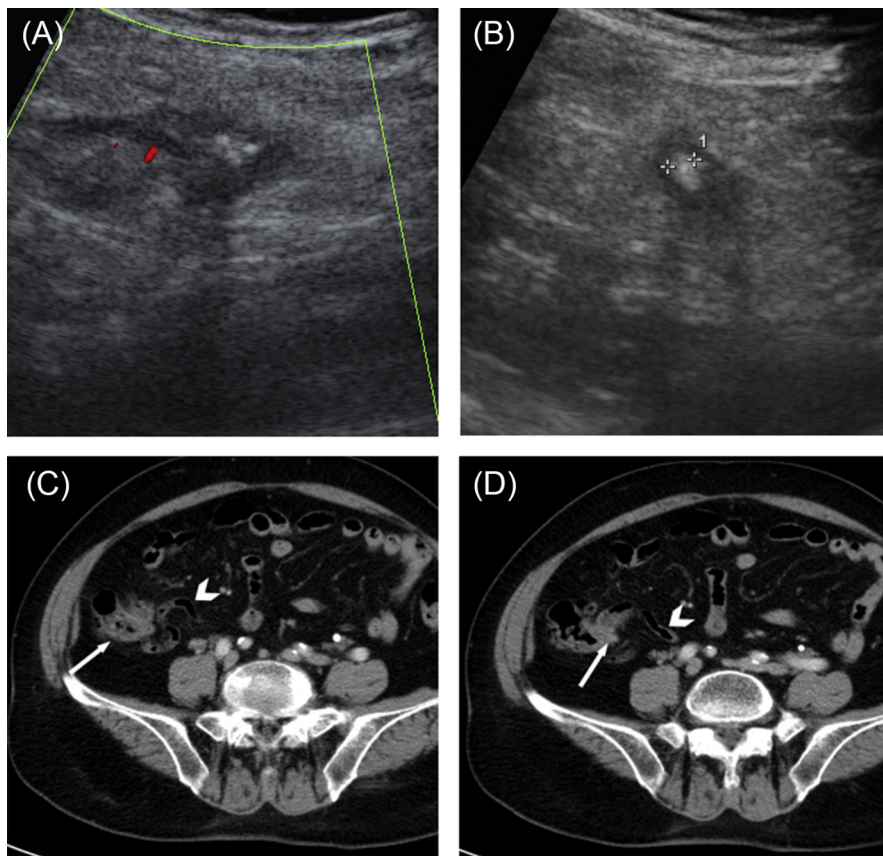


Figure 3 A 81-year-old female patient suffered from right lower abdominal pain for 5 days. (A) Sagittal scan; (B) transverse scan. Both the images show a focal hypoechoic area with blood flow and containing an intradiverticular stone; (C) and (D) contrast-enhanced computed tomography reveals cecal wall thickening and fat stranding (arrow). The appendix was relatively spared (arrowhead).

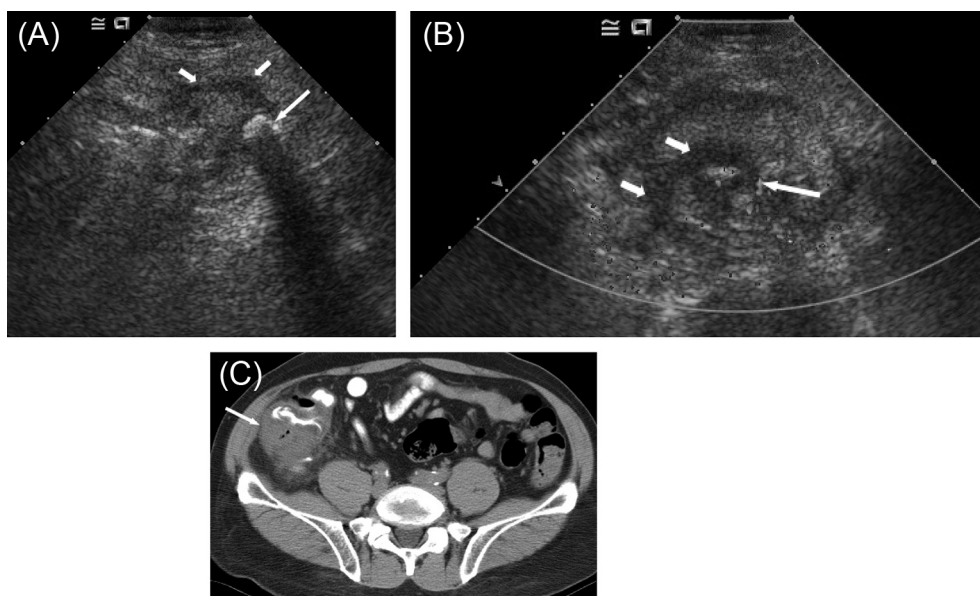


Figure 4 A 65-year-old male patient suffered from right lower abdominal pain for 3 days. (A) Sagittal scan; (B) transverse scan. Both demonstrate cecal wall thickening (short arrows), blood flow on the diverticular wall, and some echogenic material in the diverticulum (arrow), suggesting gas-forming abscess in the lumen; (C) contrast-enhanced computed tomography shows marked thickening of the wall and fat stranding along with some gas bubble (arrow), indicating diverticulitis with abscess formation.

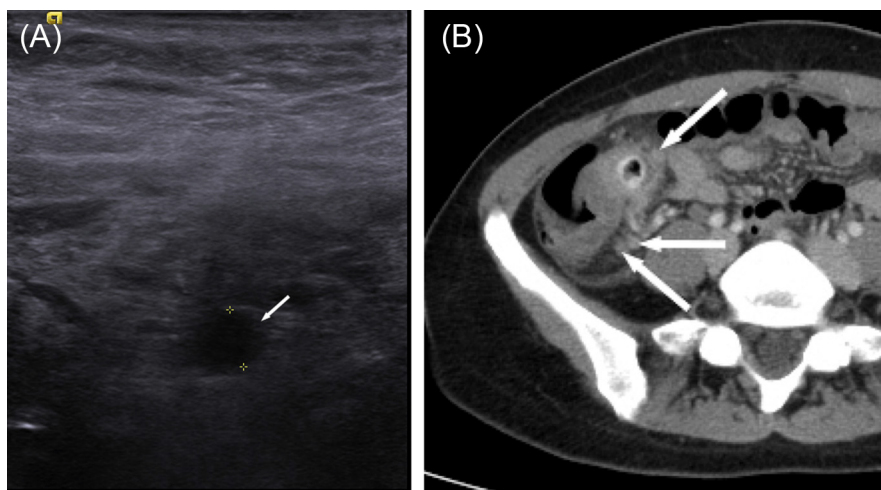


Figure 5 A 35-year-old female patient had right lower quadrant abdominal pain for 1 day. (A) Transverse scan demonstrates a hypoechoic nodule (arrow) in the pericolic region, suggesting an enlarged lymph node; (B) contrast-enhanced computed tomography scan shows several pericolic lymph nodes (arrows). In addition, colonic wall thickening and fat stranding are also noted, suggesting the diagnosis of diverticulitis.

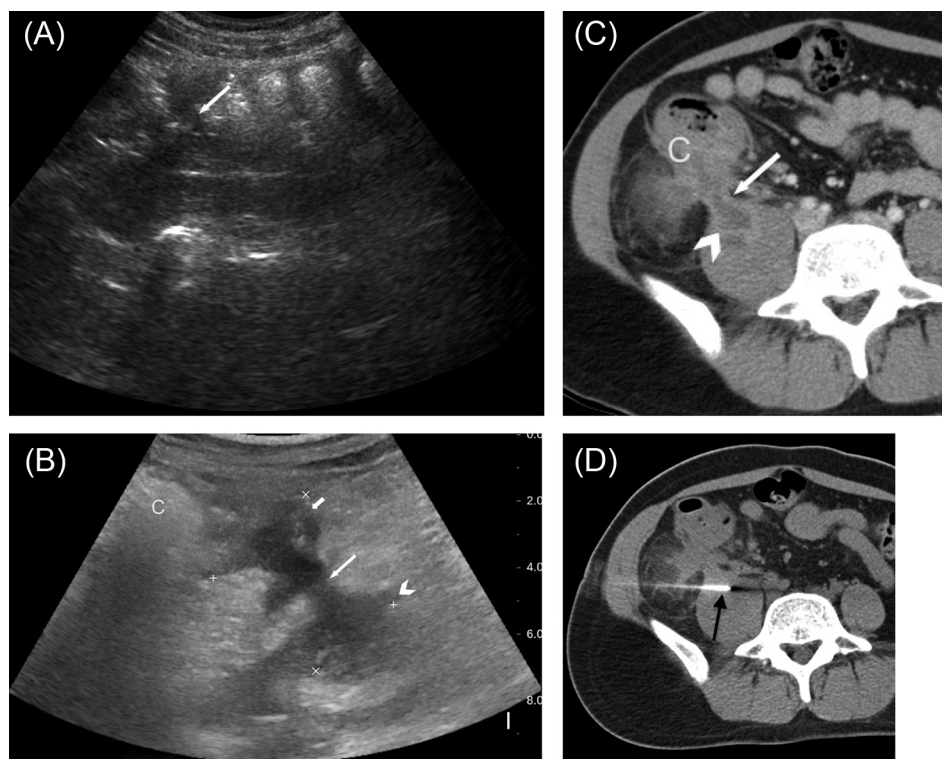


Figure 6 A 34-year-old female patient presented with right lower abdominal pain and a tender palpable mass for several days. (A) and (B) Ultrasonography shows an ill-defined localized fluid accumulation (arrow) in the right lower abdomen, connecting between a focal protruding (short arrow) and a fluid space inside the right psoas muscle (arrowhead). The small focal protruding is continuous to the cecal wall, representing an inflamed and perforated cecal diverticulum; (C) contrast-enhanced computed tomography reveals an ill-defined mass with rim enhancement, which is compatible with diverticulitis rupture and abscess formation. A fistula (arrow) between the ascending colon and right psoas muscle (arrowhead) is also demonstrated; (D) computed tomography-guided aspiration of the abscess was performed (black arrow). The patient was discharged 7 days later. No surgical intervention was done. C = cecum.

appendicitis was the presumed diagnosis in most cases [12,13]. Tan et al [14] reported an operation rate of 22.1% for right-sided acute colonic diverticulitis upon the suspicion for acute appendicitis. Most of those patients had not

received a CT scan prior to surgery. Appendectomy and right hemicolectomy [14,15] were the most commonly performed procedure. In Western countries, where US or CT were the primary imaging tools for right lower abdominal

pain, the operation rate due to presumed acute appendicitis was over 30% [16]. In contrast, none (0/14) of our patients received emergent surgery since US allowed clear and confident differentiation between acute appendicitis and right-sided colonic diverticulitis. Chou et al [17] reported an accuracy of 100% in differentiating the two diseases using US. The much higher incidence of right-sided acute diverticulitis in the Asian population might allow both radiologists and clinicians to make correct diagnosis preoperatively. The most common findings of diverticulitis in our study were diverticular wall thickening (50%) and surrounding echogenic fat (50%; Figures 1A and 2A) and intradiverticular echogenic material (50%; Figures 2A, 3A–B, 4A–B). Our findings for right-sided acute colonic diverticulitis are similar to those reported by Parulekar [18] and Zielke et al [19]. Other sonographic features, such as adjacent lymph node enlargement (Figure 5A), fluid accumulation (Figures 6A–B), and increased color flow signal (Figures 3A and 4B), were also reported by other authors [20,21]. Knowledge of the US presentations may facilitate a correct diagnosis using US and obviate an unnecessary surgery.

In our series, right-sided diverticulitis developed in the cecum and ascending colon with the same frequency (35.7%). In the other patients, the location was indistinguishable. Diverticulitis in the proximal transverse colon was not detected, probably due to its rarity [15] and the relatively small sample size. Previous studies showed a slight predominance of ascending colon over the cecum [15,22]; this may be because most patients referred for US study were due to the right lower abdominal pain.

Complicated acute colonic diverticulitis, defined as diverticulitis with associated abscess, phlegmon, fistula, obstruction, bleeding, or perforation [23–25], developed in 21.4% of our patients. Oh et al [22] reported a 57.5% rate of complicated right-sided acute diverticulitis in Korea. However, the complicated diverticulitis rate might be underestimated since the study focused on diverticulitis diagnosed by using US. Patients having more severe clinical presentation would probably receive a CT scan initially. One of our patients had a ruptured right-sided acute diverticulitis and abscess. The initial clinical presentation was also right lower quadrant abdominal pain. Sonographic evaluation demonstrated an ill-defined fluid accumulation. Under the suspicion of diverticulum rupture and abscess formation, contrast-enhanced CT study was performed, and it revealed a rim-enhancing lesion involving the ascending colon and right psoas muscle. The patient subsequently received CT-guided abscess drainage in addition to medical treatment. No surgery was performed, and the patient recovered well without other complications. Two (14.2%) of our patients suffered from abscess without overt diverticulum perforation. The sonography pattern included wall thickening, pericolic fluid accumulation, detectable color flow signal in the diverticular wall, and intradiverticular echogenic structures. On the other hand, the rest (78.5%) of our patients having uncomplicated diverticulitis were successfully managed by medical treatment, including antibiotics, intravenous fluid support, and bowel rest. The mean admission duration was 5.9 (4–8) days, and three patients were treated in the outpatient department. No subsequent complication developed during the admission period.

During the mean follow-up period of 40.7 (10–71) months, only two (14.2%) of the patients had an episode of recurrence, which developed at 2 months and 19 months after the initial attack. Several studies had evaluated the recurrence rate of diverticulitis. Mizuki et al [26] reported a recurrence rate of 24.6% in patients with mild to moderate right-sided acute colonic diverticulitis treated in the outpatient department. Two studies had suggested that the recurrence rate in inpatient and outpatient departments were similar [27,28]. One possible explanation is that a majority of our patients had minor diverticulitis; only 21.4% of them had abscess. Tan et al [15] reported a recurrence rate of 4.9% during the mean follow-up period of 40 months, which is similar to what we had observed. A majority of their patients also had Hinchey Ia disease. Furthermore, 28.6% (4/14) of the patients had received appendectomy previously, which is higher than the estimated 8.6% male and 6.7% female lifetime risk of acute appendicitis [29]. The causes have not been investigated. However, it is possible that some of them actually had a right-sided diverticulitis instead of appendicitis.

There are limitations to our study. First, it is a retrospective study. Second, the study focused on diverticulitis detected by US; therefore, the sample size is limited. It probably affected the collected patient group owing to the clinical practice tendency to select CT as the first-line screening tool for patients presenting with acute abdominal pain. Most of our patients had relatively mild severity. Third, this is a single-center study; the demographic data of our hospital may differ from the data of other hospitals. Although, there is no evidence suggesting the sonographic appearance differ between the elderly and young, treatment approach might be influenced by patient condition. Finally, the diagnosis of diverticulitis was usually made clinically. Few cases had pathologic proof.

In conclusion, right-sided acute colonic diverticulitis is usually a benign and self-limiting condition. Surgery is rarely needed. US features, including diverticular wall thickening, surrounding echogenic fat, intradiverticular echogenic material, provide clear information for making correct preoperative diagnosis. Ambiguous US studies may be complemented with a contrast-enhanced CT. Recognizing the clinical patterns and image appearances can obviate unnecessary appendectomy.

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