

Ultrasonographic Detection of Intestinal Complications in Crohn's Disease

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The aim of this study was to evaluate the sensitivity and specificity of ultrasound (US) in assessing the main abdominal complications of Crohn's disease (CD), such as strictures, fistulas and abscesses. A series of 98 consecutive inpatients with complicated and uncomplicated Crohn's disease, having undergone a complete endoscopic and radiographic evaluation of the intestinal tract, entered the study. In particular, in these patients the presence of strictures, fistulas, and abscesses, detected by means of colonoscopy, small bowel x-ray, double-contrast barium enema, and computed tomography, was also assessed by means of transabdominal US. US sensitivity and specificity in the assessment of stenosis of Crohn's disease were 74.4% and 93.1%, respectively. When ileal and colonic stenosis were considered separately, transabdominal US correctly assessed 84.6% of ileal stenosis and 58.8% of colonic stenosis. Eight of 12 fistulas were detected, but only 50% of enteroenteric fistulas were diagnosed. The presence of abscesses was correctly detected in 83.3% of cases by means of US. Our data suggest that US is a suitable complementary method for the detection of abdominal complications of Crohn's disease, such as strictures and abscesses; however, its usefulness in assessing enteroenteric fistulas seems to be fairly limited.

KEY WORDS: ultrasound; Crohn's disease; stenosis; fistulas; abscesses.

Stenosis, fistulas, and abscesses are the main complications of Crohn's disease and the most common reasons for surgery (1, 2). They are usually diagnosed by means of endoscopy and abdominal radiography, namely, small bowel x-ray, double-contrast barium enema, and computed tomography. The role of ultrasonography in the diagnosis of Crohn's disease has been widely investigated and well defined, showing a sensitivity and specificity ranging of 67-96% and 79-97%, respectively, (3-10). However, the usefulness of ultrasound in the detection of abdominal complications of Crohn's disease, in particular in the diagnosis of strictures and fistulas, has not been previously investigated. Until now, the role of ultrasonography

in confirming the presence of small bowel obstruction in diseases differing from Crohn's disease, and in the detection of abdominal abscesses, has proved to be of value (8, 11, 12). However, no study has evaluated the sensitivity and specificity of ultrasonography in detecting the main abdominal complications of Crohn's disease, such as strictures, fistulas, and abscesses. Ultrasound, being a noninvasive, simple, and cheap tool, is often recommended in the detection and follow-up of suspected and diagnosed Crohn's disease, not as a substitute for contrast radiography, but as an adjunct and precursor to other, more invasive and expensive tests (3, 13). Thus, the possibility of detecting the above-mentioned complications may be useful in the management of the Crohn's disease patient.

In a prospective study we investigated the sensitivity and specificity of ultrasound in detecting stenosis, fistulas, and abscesses complicating Crohn's disease.

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MATERIALS AND METHODS

From February 1994 to September 1995, a series of consecutive inpatients was evaluated by abdominal US in our department. All the patients who entered the study had a firm diagnosis of CD (14), having undergone complete evaluation of the intestinal tract by means of colonoscopy, small bowel x-ray, double-contrast barium enema, and computed tomography and on these bases, it was possible to ascertain or to exclude the presence of intestinal complications (stenosis, fistulas and abscesses). In particular, the diagnosis of stenosis was defined according to the usual radiographic and/or endoscopic criteria; fistulas were confirmed or excluded in all patients by means of radiographic studies (percutaneous fistulography included); computed tomography was used to diagnose abdominal abscesses and was performed only in patients with such a clinical course (fever, abdominal pain, etc) as to justify it, if previously performed US examination showed the presence of an abscess. The patients underwent all the above-mentioned examinations and a transabdominal sonographic evaluation during a course of 12 ± 4 days (mean time spent in our department in the hospital).

Sonographic evaluation was performed by the same physician before any other examination, so that he was unaware of the patient's radiologic data, in particular concerning anatomic distribution and complications of Crohn's disease, but informed (whenever possible, obviously excluding the new cases) concerning the diagnosis of Crohn's disease. He was also aware of any surgical resection performed previously. Sonographic scans of the whole abdomen were carried out with a real-time scanner device (Ecotron-Aloka SSD-680). The examination was begun with a convex 3.5-MHz transducer and, for detailed evaluation, a linear 7.5-MHz transducer was then used. No special preparation, such as fasting, administration of spasmolytic agents, or water instillation into the bowel was given. Ultrasonographic presence of stenosis, fistulas, and abscesses were defined as follows:

Stenosis was considered present at US examination when there was the coexistence of thickened (more than 4 mm) and stiff intestinal wall, narrowed intestinal lumen along with distended fluid, or echogenic content-filled loops (Figure 1) just above the thickened intestinal tract, as previously described (3, 5, 11).

Enterocutaneous or enteroenteric fistulas were considered present when detection of hypoechoic ductlike structures with fluid or air content was seen between skin and intestinal loops or between one loop and another loop, respectively. In particular, enteroenteric fistula was considered present when the passage of fluid echogenic material from loop to loop could be documented (Figure 2), and only suspected when a hypoechoic ductlike structure with air was seen between the loops (Figure 3). Fistulas between the bowel and the urinary bladder were proved when echogenic content was seen in the bladder and/or the passage of echogenic material could be seen from a thickened bowel loop to the urinary bladder.

The presence of abscesses was considered according to the current literature (12) (Figure 4).

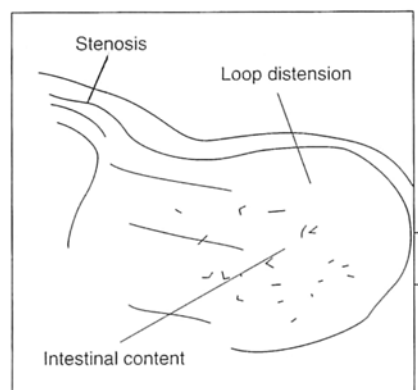


Fig 1. Longitudinal scan of terminal ileum in patient with intestinal obstruction. Bowel wall thickening with luminal narrowing and loop distension with large quantities of echogenic content.

RESULTS

Of a total of 112 patients seen consecutively in this study, 33 patients received only a complete colonoscopy and/or double-contrast barium enema, and in 19 of these a satisfactory evaluation of the terminal ileum was feasible; 79 patients were examined by means of colonoscopy and/or double-contrast barium enema and small bowel x-ray. On this basis, 14 patients with only colonic involvement, in whom US did not show a small bowel wall thickness and in whom colonoscopy or barium enema did not evaluate the terminal ileum, were excluded, and 98 patients were studied for the presence of stenosis and fistulas and suitable for the evaluation of the accuracy of ultrasonography. Moreover, the presence of abscesses was evaluated in 58 patients who underwent computed tomography.

Bowel wall thickening was present in 96 of 98 patients (one was a false negative result and one was a true negative in a postoperative control). The clin-

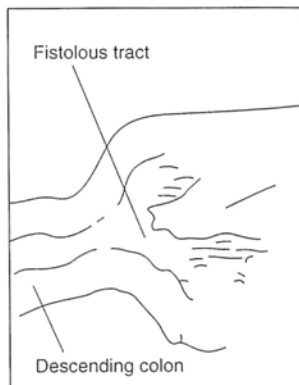


Fig 2. Fistulous tract of descending colon with clearly evident passage of fluid echogenic material.

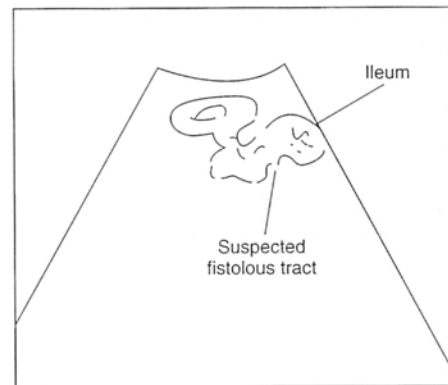
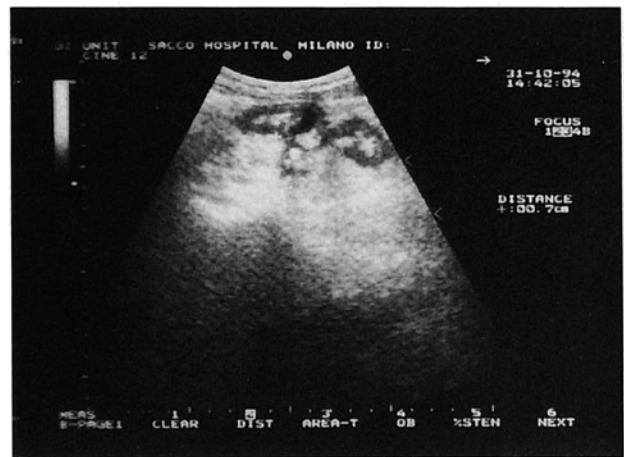


Fig 3. Suspected fistulous tract of terminal ileum with hypoechoic ductlike structure where air was seen between the loops.

ical characteristics of the patients are reported in Table 1.

According to endoscopic and/or radiographic examinations, 40 patients with stenosis were identified, and US evaluation correctly detected 74.4% (32 of 43) of stenosis in these cases. In particular, US correctly assessed 22 of 26 stenoses in the small bowel and 10 of 17 stenoses of the colon ($P = 0.124$ by chi-square analysis) (Table 2). Among the seven colonic false negative US detections, three patients had concomitant ileal stenosis as well.

US sensitivity did not seem to be significantly affected by ileal or colonic site of the stenosis, disease activity, previous surgical resection, or kind of current treatment (Table 3). Of the 40 patients with stenosis, 15 underwent surgery for resection or plastic stricture within a month. In 14 of these 15 patients, US showed the presence of stenosis.

The presence of enterocutaneous and enteroenteric fistulas was correctly assessed in three of three (all confirmed by percutaneous fistulography) and in

four of eight cases (50%), respectively. Of the latter, only in one case was the passage of fluid echogenic material from loop to loop demonstrated with US, and radiological examination confirmed the presence of the fistula; fistulas between the bowel and urinary bladder were identified correctly in only one patient (Table 4).

In 58 of 98 patients whose clinical and US findings were studied by means of computed tomography, six abscesses were diagnosed. All these were confirmed during surgery or on the basis of clinical outcome. Of these, five (83.3%) were identified by US (Table 5).

DISCUSSION

There is little doubt that endoscopy and x-ray double-contrast studies are the most accurate methods for demonstrating both the minute mucosal lesions and major abdominal complications of Crohn's disease. However, these invasive procedures may be contraindicated in some cases (ie, pregnant women,

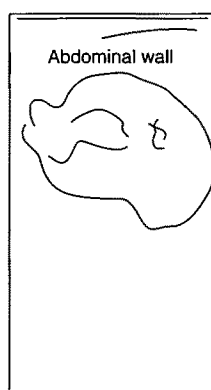
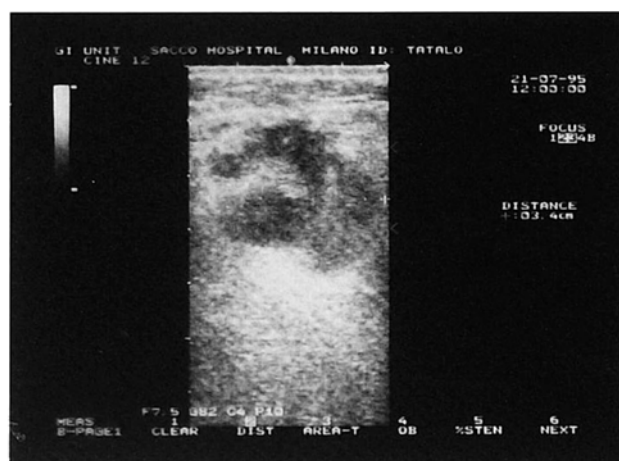


Fig 4. Ultrasonographic appearance of an abscess of anterior abdominal wall. It is a round anechoic lesion with internal echoes, irregular wall, and posterior echo enhancement.

TABLE 1. DESCRIPTION OF STUDY SAMPLE

Characteristics	%	Mean ± SD	N
Female	47.9		47
First attack	32.6		32
Age (yr)		33.7 ± 11.9	98
Length of CD (months)		72.1 ± 68.8	98
Previous surgical resection	24.4		24
Present steroid treatment	21.4		21
Absence of treatment	47.9		47
CDAI (Best)		168.2 ± 87.4	93
Active CD*	51.6		48

* CDAI (Best) > 150.

TABLE 2. SENSITIVITY AND SPECIFICITY OF US IN DETECTING STENOSIS AS X-RAY AND/OR ENDOSCOPY EVALUATED*

X-ray/endoscopy	Ultrasonography				Sensitivity (%)	Specificity (%)
	True positive	True negative	False positive	False negative		
Ileal stenosis (26)	22	73	2	4	84.6	97.3
Colonic stenosis (17)	10	82	2	7	58.8	97.6
Total stenosis (43)	32	54	4	11	74.4	93.1

* In 40 patients, 26 with ileal stenosis, 17 with colonic stenosis (three had both ileal and colonic stenosis).

TABLE 3. PATIENT CHARACTERISTICS AFFECTING SENSITIVITY OF US IN DETECTION OF STENOSIS

Characteristic	True positive US result	False negative US result	P
Site of stenosis (ileal/colonic)	22/10	4/7	0.124
CD activity (active/quiescent)	18/9†	5/6	0.397
Previous surgical resection (Y/N)	15/14	2/9	0.119
Present steroid treatment (Y/N)	7/22	5/6	0.354

* Chi-square analysis and Fischer exact test where appropriate.

† CDAI data are available for 27 of 29 of these patients.

patients with very active disease, etc) and, moreover, are poorly suited to routine follow-up of patients. A number of studies have shown that transabdominal US enables us to obtain information about the transmural intestinal changes in inflammatory bowel diseases and therefore can be used as a simple and noninvasive alternative diagnostic method in these patients. However, if the role of US in the diagnosis of CD has been widely investigated and well defined (3–10, 15–17), its usefulness in detecting CD strictures, fistulas, and abscesses remains controversial. To date, even if investigators currently describe and illustrate stenosis in CD (3, 5, 8, 15, 18) and state that fistulous communications may be seen on ultrasound (19), the sensitivity and specificity of transabdominal US in detecting such complications has not been evaluated.

To our knowledge, only one retrospective study has evaluated the reliability of sonographic evaluation in detecting small bowel obstruction (11). This study showed that sonography may be helpful in the confirmation of the presence of obstruction showing a correct diagnosis of obstruction in 89% of the cases, a percentage higher than ours. Unfortunately, no Crohn's disease patients were included in the study by Ko et al (11); moreover, their's was a retrospective study. All patients had small bowel obstruction and underwent surgery. Thus, it was not possible for a false-positive diagnosis to be made. The different result may be due not only to a different study design (we investigated a series of consecutive CD patients

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TABLE 4. SENSITIVITY AND SPECIFICITY OF US IN DETECTING FISTULAS EVALUATED BY X-RAY

<i>X-ray/endoscopy</i>	<i>Ultrasonography</i>					
	<i>True positive</i>	<i>True negative</i>	<i>False positive</i>	<i>False negative</i>	<i>Sensitivity (%)</i>	<i>Specificity (%)</i>
Enteroenteric fistulas (8)	4	86	4	4	50.0	95.5
Enterocutaneous fistulas (3)	3	95	0	0		
Enterourinary fistulas (1)	1	97	0	0		
Total fistulas (12)	8	82	4	4	66.6	95.5

prospectively) but, in particular, to quite different kinds of patients. Ko et al investigated a series of patients with intestinal obstruction, while we studied CD patients with and without stenosis complications, which were seldom acute enough to need urgent surgical therapy. In fact, in the patients with more serious stenosis who underwent surgery, US correctly showed complications of the stenosis in 96% of the cases.

In our opinion, the differing seriousness of the stenosis, which is difficult to evaluate quantitatively by means of radiography, may contribute to decreasing the accuracy of US in detecting this kind of complication when, according to the literature (3, 5, 11), dilated bowel loops are taken as a marker of stenosis or obstruction. Moreover, conditions other than degree may be associated with a lower US sensitivity in the detection of CD stenosis, such as the site of lesions, clinical characteristics of the patients and CD, operator experience, and the actual US definition of stenosis. As far as the site of the lesion is concerned, we found a reduced, although not statistically significant, sensitivity in the detection of colonic stenosis. However, it is possible that in our study this was due to the presence of concomitant ileal stenosis in three of seven false-negative patients. The presence of proximal ileal stenosis may reduce the content into the distal tract of the bowel, and consequently its dilatation and width, resulting in a lower sensitivity in detecting distal stenosis when usual criteria are considered.

As far as the usefulness of US in determining the presence of fistulas is concerned, we found an overall

low sensitivity and specificity, in particular when enteroenteric fistulas are present. The difficulty of US in detecting such complications may be due to the presence of air in the bowel since enteroenteric fistulas can lead to the recirculation of intestinal contents and the consequent stasis promotes bacterial overgrowth and gas production in the small bowel. This fact may be supported by some studies that investigated the role of endosonography in diagnosing perianal and pericorectal fistula in Crohn's disease (20, 21). Endosonography, avoiding an air-bowel contact interface, proved to be an excellent screening method for detecting and evaluating anorectal fistulas in CD patients. However, it should take into consideration that, since enteroenteric fistulas cannot always be detected by radiographic examination, the false positive rate of sonographic diagnosis may also be overestimated. However, to date, no study has evaluated the role of transabdominal US in these fields, and we hope that further studies confirm our results.

More data are available about the role of US in detecting abdominal abscesses, even though only a few of these evaluated this in Crohn's disease. However, considering computed tomography as the gold standard in detection of abdominal abscesses due to its very high sensitivity and specificity (12), we found US to have good accuracy in diagnosing this kind of lesion, in particular when it was not an intraabdominal one. Our results are in agreement with others in the literature (12, 22), in particular when CD patients were considered (8). However, the low number of patients with fistulas and abscesses seen in our study population (12.4% of fistulas and 6.1% of abscesses)

TABLE 5. SENSITIVITY AND SPECIFICITY OF US IN DETECTING ABSCESSES (58 PATIENTS)

<i>Computed tomography</i>	<i>Ultrasonography</i>					
	<i>True positive</i>	<i>True negative</i>	<i>False positive</i>	<i>False negative</i>	<i>Sensitivity (%)</i>	<i>Specificity (%)</i>
Abdominal abscesses (3)	2	52	3	1	66.6	94.5
Pariental abscesses (3)	3	55	0	0		
Total abscesses (6)	1	49	3	1	83.3	94.2

does not permit us to make any conclusive statement about the role of US in detecting fistulas or to strongly confirm the usefulness of US in diagnosing abdominal abscesses. These data however, do suggest also that US may constitute an alternative to more invasive and expensive procedures, in the assessment and follow-up of CD patients, not only to detect the disease (3–10) but also to evaluate the presence of some of its abdominal complications, such as strictures and abscesses, but not enteroenteric fistulas.

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