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Gastrointestinal Radiology

Relevance of the Barium Follow-Through Examination in the Diagnosis of Adult Celiac Disease

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Abstract. Significant changes on a standard barium follow-through examination in celiac disease have been determined by comparison with functional changes (irritable bowel syndrome), malabsorption without a villous lesion (chronic pancreatitis), and a villous abnormality without malabsorption (dermatitis herpetiformis). Patients with iron deficiency anemia formed the control group. Slight jejunal dilatation (26–30 mm) was found in 15% of the celiacs and 17% of the irritable bowel patients. Dilatation in excess of 30 mm and/or effacement of jejunal fold pattern occurred only with an abnormal jejunal biopsy, in 54% of the celiacs and 33% of the dermatitis herpetiformis patients. Patients with malabsorption by itself and 46% of the celiacs could not be distinguished from those with irritable bowel syndrome. The concept of a malabsorption pattern is considered invalid, and the diagnosis of celiac disease can be reliably established only by peroral jejunal biopsy.

Key words: Barium studies, small bowel – Celiac disease – Malabsorption.

Changes in the barium follow-through examination with nontropical sprue were first described by Mackie in 1933 [1]. The characteristic features of celiac disease have been described as jejunal dilatation with thick transverse mucosal folds, flocculation, segmentation, and delay in transit of the contrast medium [2]. These features have been considered highly specific for celiac disease [3]. However, the role of radiology in establishing the diagnosis has been altered by peroral jejunal biopsy providing a definitive histological diagnosis. It has been suggested that the only function of the barium follow-through in the investigation of malabsorption is to exclude an underlying anatomical abnormality [4]. However, a recent study has suggested that the sensitivity of the follow-through examination in detecting a small bowel lesion equals that of peroral biopsy, and the procedure can therefore be recommended for initial screening [5].

The purpose of this study is to assess the significance of changes on the barium follow-through examination in patients with adult celiac disease, both in the differentiation from other causes of malabsorption or purely functional disorders, and in relation to changes in the biochemical, nutritional, or histological parameters.

Patients

The following groups of patients were studied:

1. A control group consisting of 25 patients with iron deficiency anemia
2. 23 patients with a purely functional disorder, considered to have the irritable bowel syndrome (IBS) on the basis of their clinical presentation and exclusion of other disorders
3. 26 patients with proven adult celiac disease (ACD)
4. 12 patients with dermatitis herpetiformis (DH) to assess the effect of a villous abnormality without a nutritional disturbance. The diagnosis was established by the presence of a characteristic rash and response to the administration and withdrawal of Dapsone
5. 7 patients with chronic pancreatitis (CP) to demonstrate the effect of malabsorption without a villous lesion

Methods

Biochemical Tests

A few critical tests were chosen for analysis: the serum albumin, potassium, and fecal fats. Not all the patients in groups 1 and 2 had these tests as they were not considered necessary for the diagnosis.

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The red cell folate was measured by an automated method [6] and the fecal fats were performed by the Van der Kamer method [7].

Histology

The jejunal biopsies were taken with a Crosby capsule located at the duodeno-jejunal flexure. The mucosal thickness from the peroral jejunal biopsies was measured by an eyepiece micrometer using a standard technique [8].

Radiology

All the examinations were performed by a standard technique. Twenty minutes before the examination, 20 mg of metoclopramide was given orally. After the patient drank 250 ml of undiluted Raybar, prone views of the abdomen were taken at 30-minute intervals until the ascending colon filled.

The radiographs were examined by one author (CIB) without prior knowledge of the diagnosis. The jejunal and ileal widths were taken as an average of five transverse measurements. These were chosen from appropriate segments of the small bowel that were clearly defined and not subject to peristaltic contraction.

The jejunal fold pattern was assessed from the overall appearance of the valvulae conniventes (Fig. 1). The following gradations were distinguished:

1. A delicate crisscross pattern
2. Thickening of the folds without the folds being completely transverse
3. Folds running transversely but not thickened
4. Thick transverse folds
5. Mucosal effacement where no fold pattern was present (Fig. 2)

Statistics were performed using the Student's *t* test by Miss Monica Leighton.

Results

These are summarized in Table 1.

Jejunal Widths

Figure 3 shows the paired jejunal and ileal widths in individual patients. The mean jejunal width of the control group was 20.8 ± 5.2 mm (± 2 SD). Jejunal dilatation was significant only in patients with ACD ($P < 0.01$) and DH ($P < 0.01$). Three patients with IBS and one with CP were above the normal range of 26 mm, but all patients above 30 mm had an abnormal jejunal biopsy.

Ileal Widths

The mean ileal width in the control group was 17.9 ± 4.8 mm ($\pm$SD). Only patients with ACD showed significant ileal dilatation ($P < 0.01$), with 11 out of 24 above the normal range.

Fold Patterns

The control group was characterized by a type 1 fold pattern. Varying patterns were seen in the other groups, but type 5, mucosal effacement, was seen only in patients with severe mucosal lesions in ACD or DH with SVA.

Transit Times

In the control group transit times were all less than $1^1/_2$ hours. Delay in transit could be found in all the other groups.

Correlation of Radiological Changes Within Groups

In some patients the follow-through examination was abnormal in every feature, but many showed changes in only one or two features. The abnormalities in each group are shown in Table 2. Changes were most commonly seen in the ACD group. Nineteen out of 26 had jejunal dilatation, and in 11 this was associated with ileal dilatation. In the 15 patients with delay in transit, part or all of the small bowel was dilated. However, in five patients jejunal dilatation was present but the transit time normal. Only one ACD patient had an entirely normal follow through.

Of the changes found in the IBS patients, fold pattern variation was the most common (43%). Mucosal effacement did not occur. Ileal dilatation was not associated with jejunal dilatation.

Jejunal dilatation was found in four patients with DH. In one, ileal dilatation was associated. Jejunal and ileal dilatation were also associated in one patient with CP. Jejunal dilatation of more than 30 mm was found only with a villous lesion, i.e., in the ACD or DH groups.

Correlation of Biochemical Tests with Radiological Findings

Jejunal and ileal dilatation showed significant correlation with raised fecal fats ($P < 0.01$; < 0.01), low red cell folate ($P < 0.01$; < 0.01), and low serum albumin ($P < 0.01$; < 0.01), respectively. No correlation was found with the serum potassium levels. Although all ACD patients with abnormal serum albumin, potassium, or fecal fat had jejunal dilatation, dilatation was also found with normal biochemical levels.

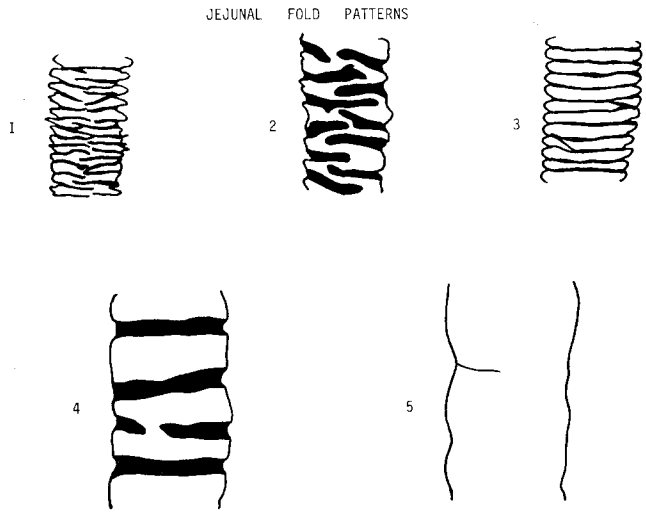

Fig. 1. Diagrammatic representation of jejunal fold patterns. *1* Normal fine crisscross pattern. *2* Thickened folds which do not run completely across the bowel. *3* Folds of normal width which run across the lumen. *4* Thick transverse folds. *5* Effacement of the fold pattern

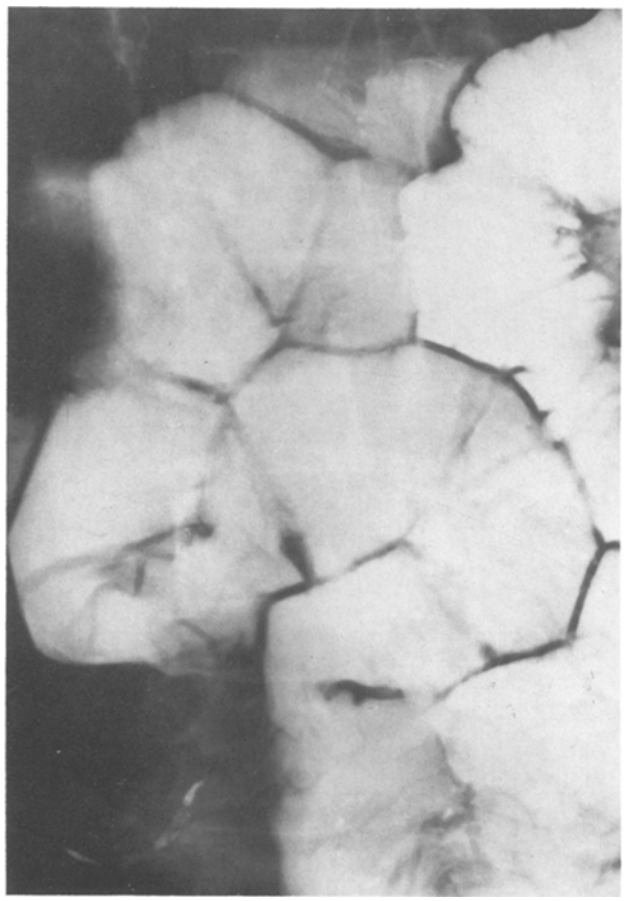

Fig. 2. Mucosal effacement (type 5). Loss of the fold pattern in the jejunum in a patient with untreated celiac disease

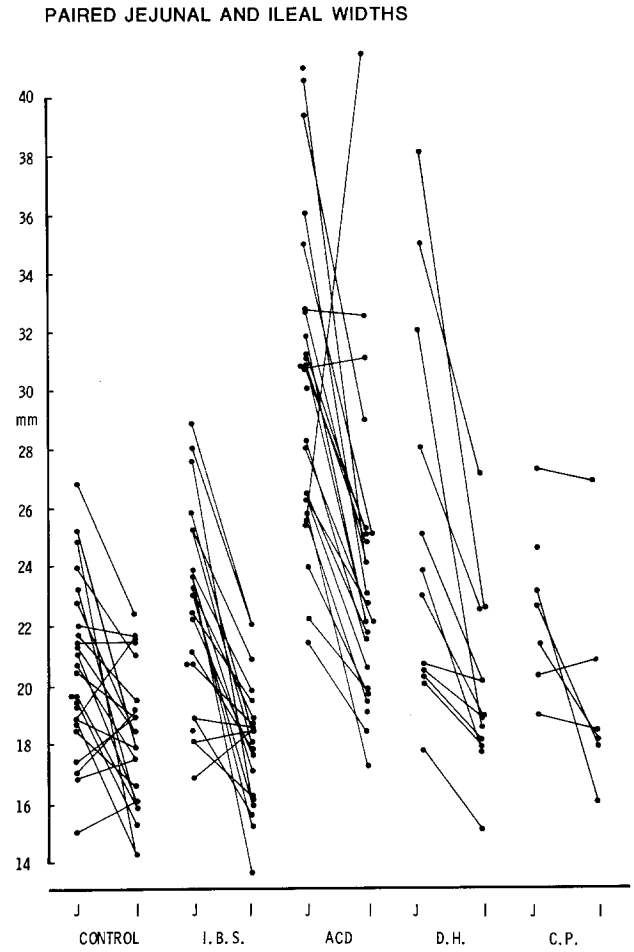

Fig. 3. *IBS,* irritable bowel syndrome; *ACD,* adult celiac disease; *D.H.,* dermatitis herpetiformis; *C.P.,* chronic pancreatitis; *J,* jejunal width; *I,* ileal width

No relationship was established between changes in the fold pattern and a low serum albumin. Similarly, delay in transit was not associated with any particular biochemical abnormality.

Correlation of the Histological Changes with the Radiological Findings

The mucosal thickness was measured in 14 patients. A significant relationship between the mucosal thickness and jejunal width was found ($P < 0.01$).

Correlation of Symptoms with the Radiological Findings

In ACD patients presenting with diarrhea, 80% had jejunal dilatation and 50% slow transit, whereas in patients with IBS and diarrhea alone, neither of these

Table 1. Results of barium follow-through examination in celiac disease[a]

	Group 1	Group 2	Group 3	Group 4	Group 5
Patients	Control	IBS	ACD	DH	CP
Total number	25	23	26	12	7
Jejunal width (mm)	20.8±5.2	22.5±6.8	30.1±11.2	25.3±12.8	22.5
Ileal width (mm)	17.9±4.8	18 ±4.4	23.8± 7.2	19.7± 4.8	19.6
Fold pattern					
1	25	13	4	8	5
2	–	4	3	2	1
3	–	4	5	1	1
4	–	2	10	–	–
5	–	–	4	1	–
Transit times (h)					
$1^1/_2$	23	16	13	9	3
$1^1/_2$–3	2	3	10	–	2
3	–	–	3	3	–

[a] IBS, irritable bowel syndrome; ACD, adult celiac disease; DH, dermatitis herpetiformis; CP, chronic pancreatitis

Table 2. Radiological abnormalities in celiac disease[a]

Patient groups	IBS	ACD	DH	CP
No. of patients	23	26	12	7
Jejunal dilatation	4(17%)	18(69%)	4(33%)	1
Ileal dilatation	–	11(42%)	3	1
Fold pattern changes	10(43%)	18(69%)	4	2
Delay in transit	3	13(50%)	3	2

[a] Abbreviations as in Table 1

parameters was abnormal. Only two ACD patients complained of abdominal pain. Of these, one had jejunal dilatation. Of the IBS patients with pain, 25% had jejunal dilatation and 28% had abnormal transit times. Of the IBS patients with pain and diarrhea, 10% had jejunal dilatation and 22% had an abnormal transit.

Discussion

A "malabsorption pattern" is often used to describe the changes on barium follow-through examinations in ACD. This term was derived from Golden's concept of "disordered motor function" [9]. It refers to jejunal dilatation, flocculation, and changes in the fold pattern and transit times, which Golden considered a nonspecific response of the small bowel to varied stimuli. However, the changes of jejunal dilatation and thick transverse folds have been ascribed to celiac disease [2, 10, 11]. The other components of the malabsorption pattern, such as the transit time and flocculation, are no longer considered relevant features of the small bowel examination, as accelerating agents such as metoclopramide and barium resistant to flocculation are now used.

In our series the upper limit of normal jejunal width was considered to be 26 mm. A previous study found this to be 25 mm [12], and Laws et al. [11] considered 30 mm to represent significant dilatation. We found that a dilatation of 30 mm or more occurred only in conjunction with an abnormal jejunal biopsy. However, in 42% of the patients with ACD the dilatation was less than 30 mm, and this compares with 21% of the patients in the Burrows and Toye series [13].

If the established upper limit of normal is considered (26 mm), then only 31% of ACD patients in our series would be within the norm, but then 17% of the IBS patients would also be abnormal.

A useful differential point is that ileal dilatation, concomitant with jejunal dilatation of >30 mm is found only with celiac disease. Such generalized dilatation of the small bowel is a noted feature of celiac disease [14, 15]. Patients with malabsorption but no villous lesion (the CP group) showed normal jejunal and ileal widths.

The fold pattern of the small bowel is produced by barium lying in between folds of the valvulae conniventes. Many factors can modify this pattern, for example, peristaltic contractions [16] or simple distention [17].

Mucosal effacement (type 5, Fig. 2) ws found to be significant as it occurred only in the presence of a severe villous lesion. Complete loss of the fold pattern has been termed the "moulage sign" [18]. This was once considered to be due to flocculation. However, it is still found when techniques such as small bowel enema are used which specifically exclude flocculation [15], and therefore must reflect loss of the valvulae conniventes.

The diagnosis of ACD on follow-through examination depends on recognizing a pattern of abnormalities. As in many small bowel conditions, the changes are not specific. Jejunal dilatation in excess of 30 mm and mucosal effacement are highly suggestive of a severe villous abnormality which may be found in

either celiac disease or dermatitis herpetiformis. However, such dilatation may also be found in patients with scleroderma, pseudo-obstruction, and gastric or small bowel resections. Minor changes in fold pattern and width are also seen in the irritable bowel syndrome. If the follow-through examination were used as a screening test [5], a number of patients with the irritable syndrome would be subjected to jejunal biopsy unnecessarily. The examination may also be entirely normal in untreated celiac disease [11, 13]. Thus although the follow-through examination may suggest changes compatible with celiac disease, the diagnosis or exclusion of celiac disease must always be by jejunal biopsy. The importance of the follow-through examination is to exclude other causes of malabsorption, such as jejunal diverticulosis, or other pathological processes such as Crohn's disease. In patients with known celiac disease the examination may be required to exclude complications such as lymphoma, carcinoma, or ulceration and stricture formation [19]. The follow-through examination has no value in demonstrating malabsorption per se [20].

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