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Abdominal radiology

Review article

Infectious ileocecitis caused by Yersinia, Campylobacter, and Salmonella: clinical, radiological and US findings

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Abstract. Yersinia, Campylobacter, and Salmonella are pathological microorganisms which incidentally may specifically infect the ileocecal area *(infectious ileocecitis)*. In such cases pain in the right lower quadrant is the predominant symptom, and diarrhea is absent or only mild. This symptomatology can lead to an unnecessary laparotomy for suspected appendicitis. At surgery a normal appendix is removed, while there is edematous thickening of ileum and cecum, and enlarged mesenteric lymph nodes. These ileocecal abnormalities give rise to a fairly characteristic US image, enabling the radiologist to rapidly differentiate infectious ileocecitis from appendicitis, thus preventing an unnecessary laparotomy. Infectious ileocecitis caused by Yersinia, Campylobacter, and Salmonella is a common mimicker of appendicitis, and its incidence at this moment is grossly underestimated. Ultrasound is presently the only means to prevent an unnecessary operation for this condition which is principally self-limiting and innocuous.

Introduction

It is well known that the bacteria *Yersinia enterocolitica, Campylobacter jejuni,* and *Salmonella enteritidis* are important causes of diarrhea in humans. It is less known that the same microorganisms may also cause an appendicitis-mimicking syndrome, in which case the infection is confined to the ileocecal area [1–20]. In these patients right lower abdominal pain is the predominant symptom, whereas diarrhea is absent or only mild. Due to this symptomatology, this otherwise innocuous and self-limiting bowel infection may lead to an unnecessary laparotomy for suspected appendicitis.

The use of US with graded compression has greatly enhanced the diagnostic accuracy in patients with acute right lower abdominal pain [21–24]. In patients with the above-described appendicitis-mimicking syndrome due to Yersinia, Campylobacter, or Salmonella, a fairly characteristic US pattern can be demonstrated. This enables a rapid diagnosis and therewith exclusion of appendicitis [25–31]. In view of the constant clinical and morphological features and its common bacterial origin, the condition has been named *bacterial ileocecitis* (Table 1) [19]. Because analogous clinical, sonographic, and barium findings have also been described in viral, fungal, protozoan, and helminthic infections of the ileocecal area, the term infectious ileocecitis may be more appropriate [32–36].

This article reflects a 9-year experience with infectious ileocecitis caused by Yersinia, Campylobacter, and Salmonella and describes its clinical, microbiological, epidemiological, radiological, and sonographic findings.

Clinical findings

History, physical examination, and laboratory tests in infectious ileocecitis caused by Yersinia, Campylobacter, and Salmonella are generally comparable to

Table 1. List of the conditions from the literature covered by the entity of infectious ileocecitis

Yersinia enterocolitis [4]
Yersinia pseudoappendicitis [6, 10]
Yersinia lymphadenitis [18]
Yersinia ileitis [38]
Yersinia terminal ileitis [31]
Acute ileitis [7, 8]
Acute terminal ileitis [3, 15]
Mesenteric adenitis and acute terminal ileitis [25]
Campylobacter-associated "appendicitis" [12]
Campylobacter ileocolitis [26]
Campylobacter enterocolitis [41]
Salmonella "appendicitis" [2]
Salmonella ileocecal lymphadenitis [11]
Salmonella pseudoappendicitis [13]

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what is found in appendicitis, the predominant symptom being acute or subacute pain in the right lower quadrant.

There are some clinical clues which may suggest the correct diagnosis:

1. Pain in infectious ileocecitis may occasionally be intermittent and colicky in nature.

2. Although diarrhea is usually mild or absent, severe diarrhea may be present at admission. Of course, in these cases clinical confusion with appendicitis is less likely to occur.

3. At physical examination local tenderness on pressure is often less prominent than in appendicitis.

4. Considering laboratory tests, in infectious ileocecitis the white cell count is elevated slightly just as in appendicitis, but the erythrocyte sedimentation rate (ESR) at presentation is often considerably higher than in acute appendicitis. In such cases the elevated ESR is often attributed erroneously to advanced appendicitis with the formation of an appendiceal phlegmon or abscess.

5. Especially in infectious ileocecitis caused by *Yersinia enterocolitica,* the clinical symptoms are often protracted and mimic those of Crohn's disease or an appendiceal mass.

The clinical signs in patients with infectious ileocecitis are not in all cases so alarming that immediate exploratory laparotomy is deemed necessary. In approximately half of the patients, symptoms are relatively mild, leading to a choice for a wait-and-see policy, rather than operation [19]. This decision can be supported by a markedly elevated ESR, suggesting the presence of an "appendiceal mass", a condition which is usually treated conservatively. If the true nature of the disease is not recognized in due course, these patients might end up undergoing an ill-advised "interval appendectomy."

In the other half of the patients the symptoms are more acute and alarming, and the patient is operated upon immediately. At laparotomy a normal appendix is found, and there is mural thickening of ileum and cecum and enlarged mesenteric lymph nodes. As already mentioned in the Introduction, these findings are often subtle and may easily escape the attention of the surgeon.

Although the removed appendix macroscopically appears completely normal, not infrequently the pathologist microscopically diagnoses "endoappendicitis," in which the inflammatory leukocyte infiltration is confined to the mucosa [9, 12]. No transmural inflammation or perforation is found. Colonoscopic biopsy of terminal ileum and cecum reveals identical features as are found in the appendix wall [9]. If an enlarged mesenteric lymph node is removed during operation, histology reveals aspecific reactive changes compatible with bacterial infection [9].

Antibiotic treatment of infectious ileocecitis is usually not necessary, with the exception of some persistent cases of *Yersinia enterocolitica.*

Microbiological and epidemiological findings

The microbiological findings in 117 patients from our institute with proven bacterial infectious ileocecitis are summarized in Table 2. These 117 patients were encountered over a period of 9 years in our institute (a 600-bed community hospital), which corresponds to approximately 1 case every 4 weeks. In the same period approximately 1300 appendectomies for acute appendicitis were performed in our hospital, which means that for every 11 cases of appendicitis, we have encountered 1 case of infectious ileocecitis. Considering the incidence of infectious ileocecitis, the most confident data for comparison come from a large bacteriological study in Belgium where the authors systematically performed stool cultures in appendectomized patients. Within a period of 10 years the authors collected positive cultures for Yersinia, Campylobacter, or Salmonella in 94 cases. In the same period in their institute (a 400-bed community hospital) 1362 appendectomies were performed [20, 37]. These consistent data emphasize the relatively high frequency of infectious ileocecitis in patients with acute right lower abdominal pain.

Although it is remarkable that a considerable number of studies from Germany, Sweden, Finland, Norway, Belgium, and the Netherlands have demonstrated a high incidence of infectious ileocecitis, it remains a rare diagnosis in most institutions [15–20]. There are several explanations for this actual underestimation:

1. Since diarrhea is usually absent or only mild, stool cultures are not likely to be requested. In case diarrhea occurs 1 or 2 days *after* the onset of abdominal pain and the appendix has been removed by that time, stool cultures may be considered no longer relevant.

2. Campylobacter and Yersinia require special culture techniques and must be specifically searched for in the stool.

3. The intraoperative findings of enlarged mesenteric lymph nodes and ileocecal wall thickening are often subtle and may easily escape the notice of the surgeon.

Table 2. Bacteriological outcome in 117 cases of proven infectious ileocecitis, encountered in the Westeinde Hospital over a period of 9 years (confirmation by stool culture in 113, by blood serology in 4)

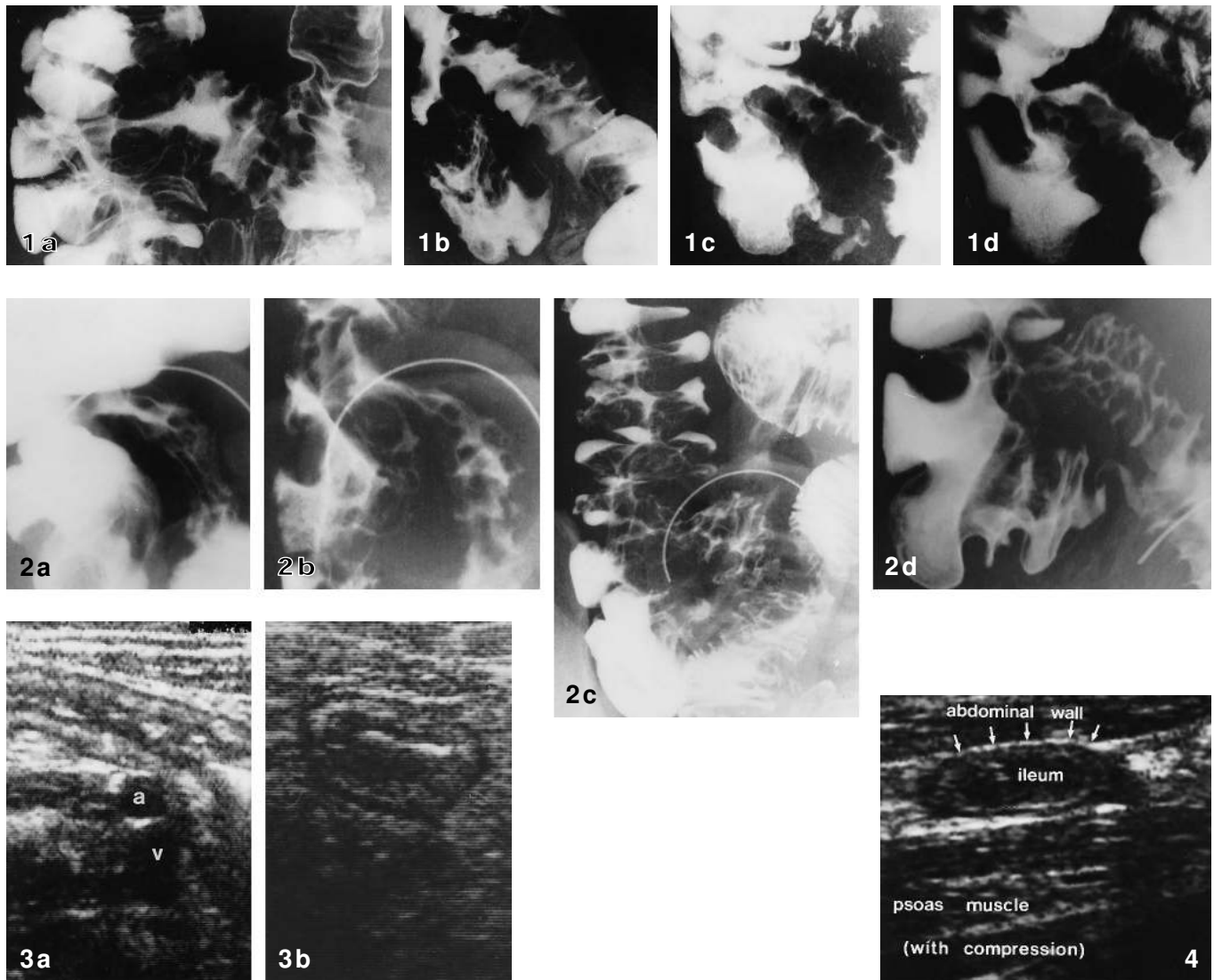|	*N*
Yersinia enterocolitica	
Type 03	26
Type 05	1
Type 08	1
Type 09	18
Yersinia pseudotuberculosis	1
Campylobacter jejuni	41
Salmonella enteritidis	
Group B	10
Group C	5
Group D	12
Group E	2
Total	117

Fig.1a–d. Infectious ileocecitis due to *Yersinia enterocolitica*. Barium studies in four patients demonstrate marked mucosal thickening of the terminal ileum. Wall thickening of the cecum is seen best during contraction.

Fig.2a–d. Infectious ileocecitis due to *Campylobacter jejuni*. Barium studies in four patients demonstrate subtle mucosal thickening of the ileum, whereas the thickening of cecum and ascending colon is more prominent

Fig.3a, b. Infectious ileocecitis. Mural thickening of the ileum in the longitudinal and axial view is limited to the mucosa and submucosa. The thin echolucent muscularis layer is *not* involved. *a, v* iliac artery and vein

Fig.4. Wall thickness of the ileum in infectious ileocecitis should be measured under *standardized* conditions: When *not* contracted, the ileum is compressed with the transducer between abdominal wall and psoas muscle. If, during compression, the short axial diameter exceeds 6 mm, this is abnormal. In this example the diameter was 11 mm

Fig.5. Involvement of terminal ileum, cecum, ascending colon, and mesenteric lymph nodes in infectious ileocecitis caused by different microorganisms. There is, however, considerable overlap

These cases are then likely to be labeled as "white appendix: no cause revealed," or, in case the patient develops diarrhea in the period *after* the appendectomy, as "gastroenteritis."

The reason that the enlarged mesenteric lymph nodes are intraoperatively easily missed is their cranial location in the mesenteric root, which is not well reachable for the surgeon palpating through the grid-iron incision. Furthermore, in obese patients the nodes are of-
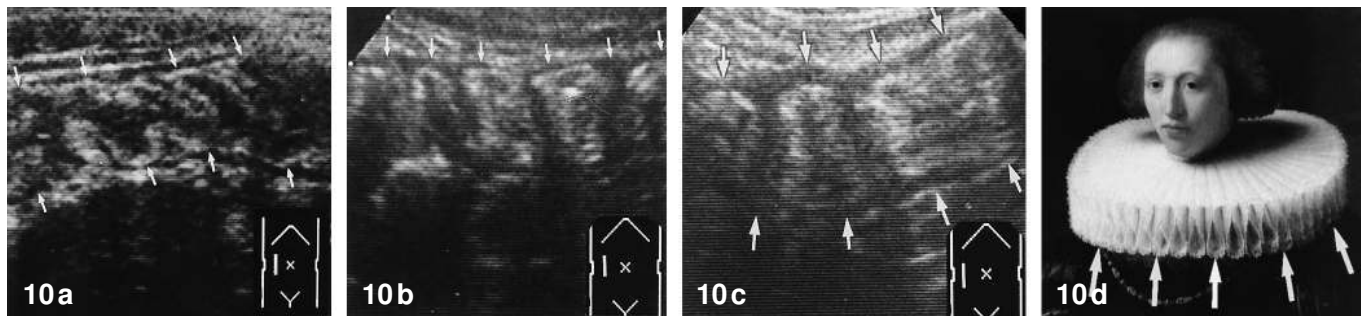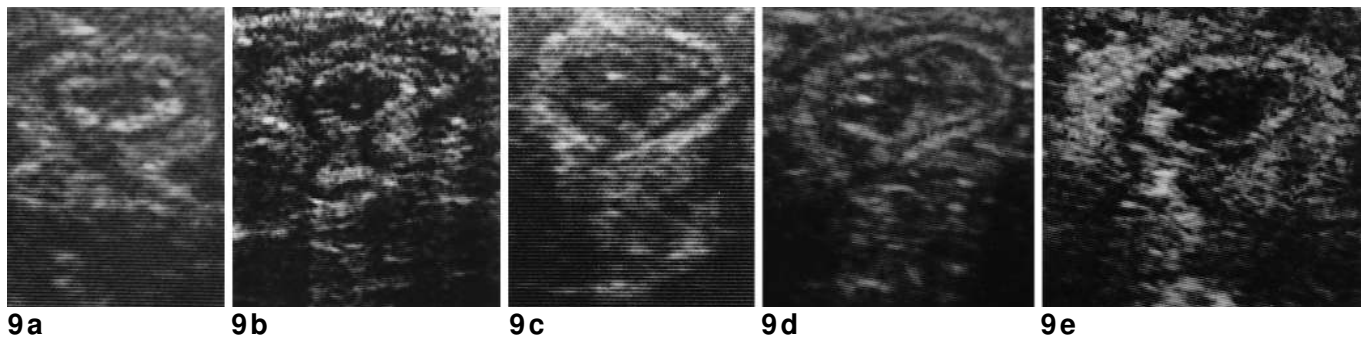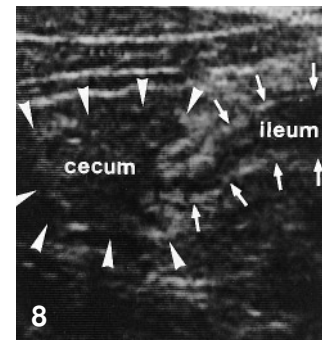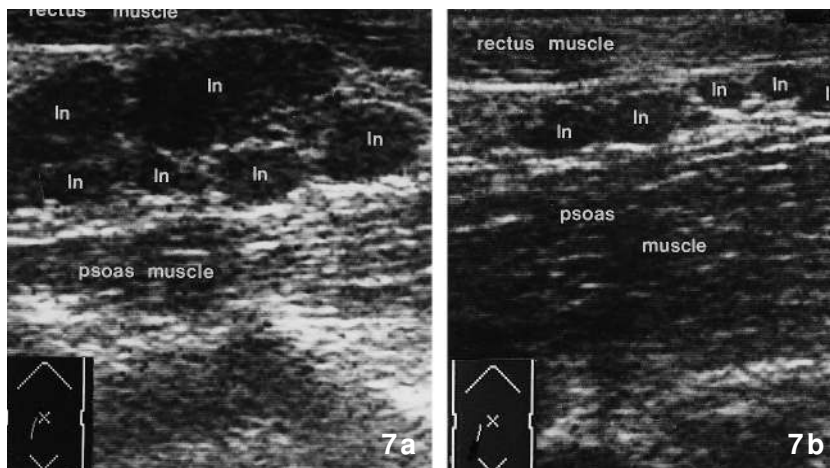
6a

6b

6c

7a

7b
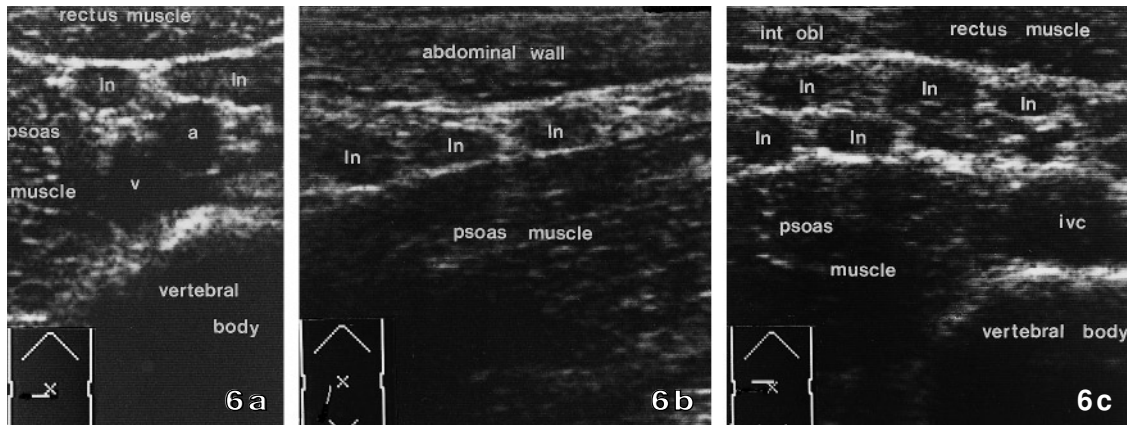
8

9a 9b 9c 9d 9e

10a 10b 10c 10d

Fig. 6a–c. Enlarged mesenteric lymphnodes *(ln)* in infectious ileocecitis. The majority of nodes are found during compression of the region slightly right of the umbilicus. *ivc* inferior vena cava; *int obl* internal oblique muscle; *a, v* iliac artery and vein

Fig. 7a, b. Slow regression of mesenteric lymph nodes in infectious ileocecitis due to *Yersinia enterocolitica.* **a** Large conglomerate of grossly enlarged mesenteric lymph nodes *(ln).* **b** The same area 8 weeks later. The nodes are still enlarged, although the patient has been symptom-free for several weeks

Fig. 8. Longitudinal view of the ileocecal valve in infectious ileocecitis: the ileum *(arrows)* seen actually entering into the cecum *(arrowheads)*

Fig. 9a–e. Typical axial view of the ileocecal valve in infectious ileocecitis in five different patients

Fig. 10a–d. Longitudinal view of cecum and ascending colon in infectious ileocecitis. The combination of mucosal thickening and contraction creates a typical haustration pattern. This resembles an Elizabethan ruff (**d**)
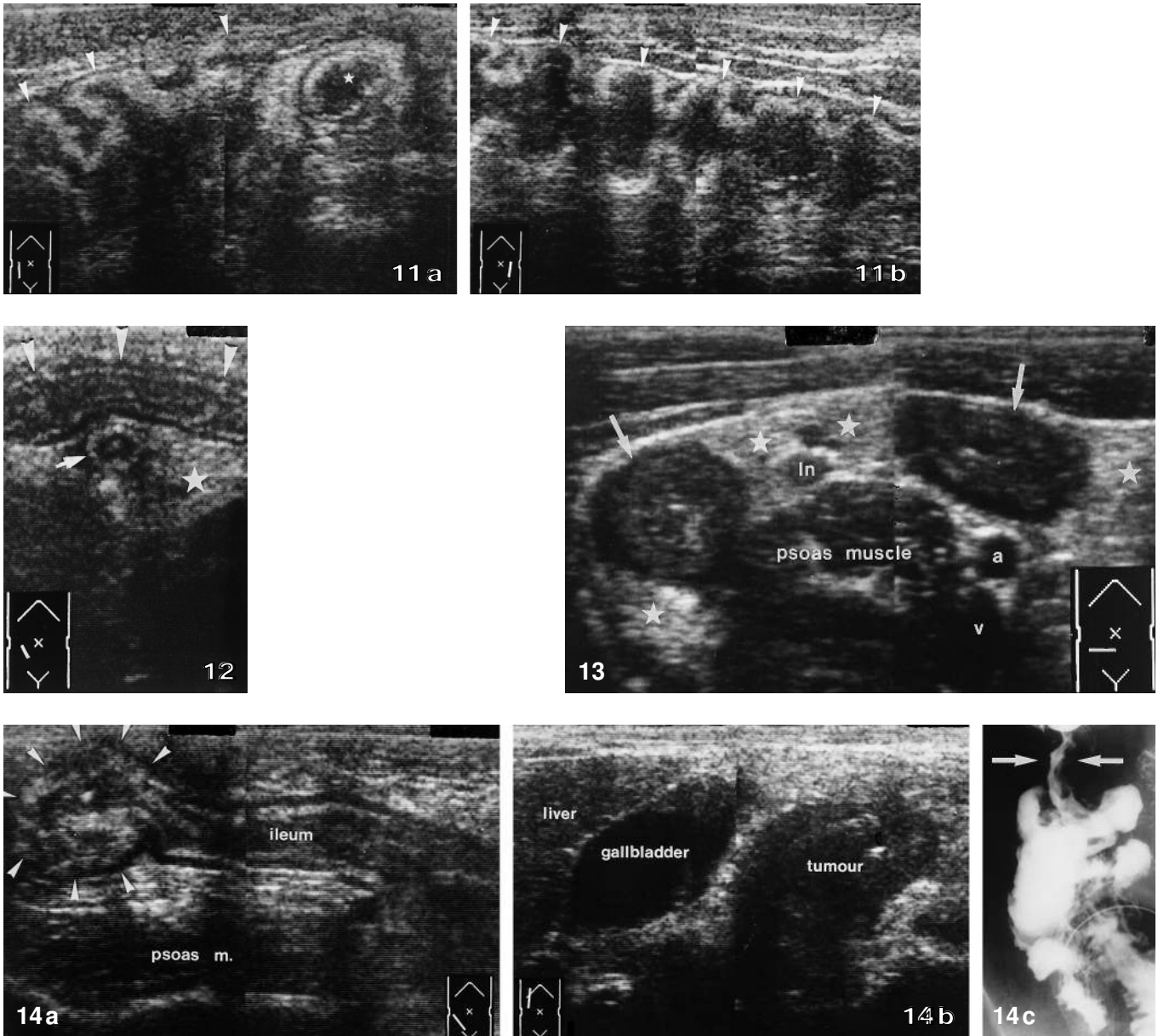
Fig. 11 a, b. Infectious ileocolitis. Mucosal wall thickening is found both in the ileocecal valve and *(asterisk)* right hemicolon as in the left colon *(arrowheads)*

Fig. 12. Pitfall: wall thickening of the ileum *(arrowheads)* secondary to acute appendicitis *(arrow)*. Note the presence of hyperechoic, non-compressible, inflamed fat *(asterisk)*

Fig. 13. Crohn's disease. Note marked transmural wall thickening of the ileum *(arrow),* which is surrounded by hyperechoic, non-compressible inflamed fat *(asterisk). ln* inflamed mesenteric lymph node; *a, v* iliac artery and vein

Fig. 14 a–c. Pitfall. Mucosal thickening of ileum and cecum *(arrowheads)* due to a colonic carcinoma in the hepatic flexure *(arrows* in **c**)

ten embedded in abundant mesenteric fat and cannot be palpated reliably.

In case the enlarged lymph nodes are prominent and well palpable, the patient is often labeled as suffering from "mesenteric lymphadenitis." Although usually subtle, the inflammatory changes of ileum and cecum may also be prominent, in which case an erroneous diagnosis of Crohn's disease can be made. Incidentally, this may even lead to an unnecessary ileocecal resection.

Radiological findings

Barium studies in infectious ileocecitis show symmetrical mural thickening of the terminal ileum and cecum. This is especially evident during contraction, where a cobblestone appearance can be found. Fistulae or abscesses are never found. The abnormalities of the ileum are most prominent in Yersinia ileocecitis, whereas wall thickening of cecum and ascending colon is more prominent in Salmonella and Campylobacter ileocecitis (Figs. 1 and 2) [38–40].

In some patients of the latter two groups, the abnormalities can extend to more distal parts of the colon. In

these cases, in which severe diarrhea is often present, it is perhaps better to speak of infectious ileocolitis, because both the ileum and the major part of the colon is involved. Barium studies in Campylobacter ileocolitis have demonstrated small mucosal ulcers in the colon [39, 41]. As mentioned previously these cases of infectious ileocolitis do not provide substantial problems in the differentiation from appendicitis, because severe diarrhea is the predominant symptom.

Sonographic findings

The sonographic hallmark of infectious ileocecitis is symmetrical mural thickening of terminal ileum and cecum. The sonographic wall thickening is confined to mucosa and submucosa *without* involvement of muscularis, serosa, or the surrounding fatty tissue (Fig. 3). Measuring of the wall thickness should be performed under standardized conditions (Fig. 4). Yersinia, Campylobacter, and Salmonella have different patterns of ileocecal affection (Fig. 5), but there is considerable overlap.

Enlarged mesenteric lymph nodes are usually present, but are not always easy to visualize, especially in obese patients. The largest nodes are found in infectious ileocecitis caused by Yersinia. The majority of mesenteric lymph nodes are found in the region slightly right of the umbilicus, both cranially and caudally (Fig. 6). The lymph nodes decrease in size slowly in the course of the disease (Fig. 7). The ileocecal valve has a characteristic sonographic aspect both in the longitudinal and in the axial plane (Figs. 8 and 9). Peristalsis is scarce, but not absent. From time to time the configuration of the ileocecal valve changes, coinciding with colicky pain experienced by the patient. During such an event the ileum, for a short moment, protrudes into the cecal lumen and then slides back. The combination of wall thickening and contraction of the haustrated right hemicolon yields a typical image in the sagittal view, reminding one of an Elizabethan ruff (Fig. 10). In patients with infectious ileocolitis in whom severe diarrhea is present, colonic wall thickening can be seen to extend more distally in the colon (Fig. 11).

In slim individuals, not infrequently the appendix can be visualized. The appendix in infectious ileocecitis has a diameter of 5 mm or less, is compressible, and is *never* surrounded by inflamed fat. These features do not differ from those of a normal appendix, so the histologically demonstrable "endoappendicitis" apparently does not cause sonographic wall thickening.

Pitfalls in the sonographic diagnosis

The most important pitfall in the sonographic diagnosis is appendicitis, in which there is secondary wall thickening of ileum and cecum (Fig. 12). If the inflamed appendix in such a case is overlooked and only the thickened ileum and cecum are denoted, an erroneous diagnosis of infectious ileocecitis may be made, which may lead to serious surgical delay. Therefore, it is always manda-

Table 3. Different sonographic features in infectious ileocecitis caused by Yersinia, Campylobacter, or Salmonella vs ileocecal Crohn's disease

Infectious ileocecitis caused by Yersinia, Campylobacter, or Salmonella	Ileocecal Crohn's disease
Bowel wall thickening confined to (sub)mucosa (no involvement of muscularis)	Bowel wall thickening principally involving all layers
Symmetrical wall thickening with intact layer structure	Often asymmetrical wall thickening with disturbed layer structure
Ileum never surrounded by inflamed, hyperechoic non-compressible fat	Ileum usually surrounded by inflamed, hyperechoic, non-compressible fat
Ileum moderately compressible	Ileum hardly compressible
Characteristic axial image of the ileocecal valve	Ileocecal valve often not recognizable (gradual transition of ileum into cecum)
Prominent haustration of cecum and right colon	Often lost haustration of cecum and right colon
If visualized, the appendix is small ≤ 5 mm	Appendix often enlarged ≥ 6 mm
Mesenteric lymph nodes moderately to grossly enlarged	Mesenteric lymph nodes moderately to grossly enlarged
Never abscesses, fistula formation, nor pre-stenotic dilatation	Often abscesses, fistula formation, or pre-stenotic dilatation

tory to keep searching for an inflamed appendix in patients with mucosal thickening of ileum and cecum. In this respect an important discriminatory finding is the presence of non-compressible, hyperechoic inflamed fat which is almost invariably present in advanced appendicitis and is never present in infectious ileocecitis (Fig. 12).

A second pitfall is Crohn's disease, especially in the differential diagnosis with Yersinia ileocecitis (Fig. 13). The various US features of ileocecal Crohn's disease and bacterial ileocecitis are summarized in Table 3. Despite all these features, in some patients it may be impossible to differentiate Yersinia ileocecitis from ileocecal Crohn's disease. In these cases serology and clinical-sonographic follow-up provide the clue. Other more rare pitfalls are wall thickening of ileum and cecum secondary to a carcinoma of the ascending colon (Fig. 14) [30], lymphoma, eosinophilic enteritis [42], intussusception, and small bowel ischemia.

A potential pitfall is coexistent appendicitis in a patient with infectious ileocecitis. Although this has been described in the literature [16, 20], we have not encountered a single case in 9 years.

Conclusion

Infectious ileocecitis caused by Yersinia, Campylobacter, or Salmonella is a common disorder and provides a substantial health problem in western Europe,

due to its ability to mimic an acute abdomen. Sonography is presently the best tool to rapidly differentiate this otherwise innocuous and self-limiting disease from appendicitis, thereby preventing an unnecessary laparotomy.

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