Abdominal Ultrasound in Infectious Enteritis

a report by
Luciano Tarantino
Director of Hepatology and Interventional Ultrasound Unit, Department of Medicine, San Giovanni di Dio Hospital

The diagnosis of infectious enteritis is usually based on clinical history, symptoms and serological and cultural tests. However, in many cases symptoms can mimic other intestinal diseases (e.g. appendicitis, inflammatory bowel diseases) or can be indistinguishable from disease involving other abdominal organs. Ultrasoundography (US) is a fast, effective, non-invasive and well-tolerated diagnostic tool that has proved to be effective in the diagnosis of many acute and chronic diseases of the gastrointestinal tract as well as in other abdominal syndromes. US can be usefully employed for fast detection of enteritis in order to exclude unnecessary laparotomies or, in contrast, to avoid delaying prompt surgical therapy. Furthermore, since US is a repeatable and well-tolerated examination without any significant side effects, it can be used for frequent follow-up of patients with doubtful diagnosis or severe enteritis.

Infectious Enteritis and Colitis

The most frequent causes of bacterial enteritis and colitis in Italy are Escherichia coli and Salmonella spp. In these infections, abdominal US examination can show ileal and/or colonic involvement. US findings include:

- Diffuse ileal and/or colonic wall thickening in 36–81% of cases. In the transverse and axial US scans, the gastrointestinal tract shows a ‘target-like’ appearance and a ‘multiple parallel bands’ appearance, respectively (see Figures 1a and 1b). The inner hypoechoic layer (mucosa) and middle hypoechoic layer (submucosa) are generally diffusely thickened (see Figures 2a and 2b) while the muscular layer is normal. Since the mucosal walls are effaced, the absence of intraluminal gas results in excellent visualisation of the intestinal aspect.
- Enlargement of mesenteric lymph nodes (see Figure 2c). This enlargement in 56%.
- Perivisceral (mainly peri-ileal) soft tissue hyperechogenicity because of oedema and inflammation.
- Ascites and fluid collections.

The severity and persistence of US findings depend upon the infectious disease. In the advanced phases of Crohn’s disease, while early phases can show an aspecific inflammatory US pattern very similar to infectious ileocaecitis.

It has been widely shown that US may reveal a high incidence of infectious ileocaecitis in patients with acute right lower quadrant pain suspected for appendicitis. Sonography is useful in the differential diagnosis between infectious ileocolitis, Crohn’s disease and appendicitis.

Because of the wide variability of clinical signs, prevalence and incidence of bacterial ileocaecitis, as well as the sensitivity of US, the diagnosis of ileocaecitis is not well described. In a prospective study in a large series of adult patients affected by typhoid fever, wall thickening of ileum and/or ascending colon was reported in 36% and mesenteric lymph node enlargement in 56%.

In patients with shigellosis, an acute bacterial infection presenting with bloody diarrhoea usually involving the colon and a diffuse wall thickening...
Abdominal fluid in children with infectious enteritis can distinguish thickening, ascites is usually absent in rotavirus colitis. In some viral enteritis from colitis due to rotavirus. In fact, despite the mural and the invagination showed spontaneous resolution after 20 minutes from the diagnosis. D: 'Target inside target' pattern of ileoileal invagination in enteritis. In this case the symptoms of the intestinal aspect.

A, B: Axial and transverse ultrasound scans of the last ileal loop. The mucosa layer (M) and the submucosa (S) are moderately diffusely thickened, while the muscular layer is normal. The lumen (L) is hyperechoic; the inner hypoechoic layer (M) corresponds to the mucosa; the outer hypoechoic layer (M1) corresponds to the muscularis.

In the transverse ultrasound (US) scan, the gastrointestinal tract shows a 'target-like' appearance (A), while in the axial US scan it shows a 'multiple parallel bands' appearance (B). The lumen (L) is hyperechoic; the inner hypoechoic layer (M) corresponds to the mucosa; and the outer hypoechoic layer (M1) corresponds to the muscularis.

Gastroenteritis infection from enterotropic viruses (rotavirus, adenovirus, Epstein-Barr virus) is frequently encountered in children. In these cases, the main US sign is a significant enlargement of mesenteric and abdominal lymph nodes. The bowel wall thickness is rarely increased. Sonographic detection of ascites or intra-abdominal fluid in children with infectious enteritis can distinguish S. enteritis from colitis due to rotavirus. In fact, despite the mural thickening, ascites is usually absent in rotavirus colitis. In some viral infections (e.g., Epstein-Barr virus), the severity of mesenteric lymph node involvement (see Figure 3) can suggest lymphoma; the fast and progressive decrease of lymph node hypertrophy at US follow-up helps in excluding lymphoma or other infectious conditions (such as abdominal tuberculosis).

Tuberculous Enteritis and Colitis
Tuberculous enteritis is generally described in young adults. In 90% of cases it involves the ileoocaecal tract and presents with a palpable mass in the right lower quadrant and/or complications of obstruction, perforation or malabsorption. Symptoms are rarely specific. Rx barium studies may show strictures, dilatation of bowel loops, narrowing of the terminal ileum, and distortion of caecum and ascending colon, but cannot detect mural lesions of ileum and colon and peritoneal involvement. US is very useful for imaging intestinal and peritoneal tuberculosis. Bowel wall thickening is best appreciated in the ileocaecal region. In the early phases, ileocaecal phlegmon may show only regular thickening of muscosa and submucosa, a pattern that can mimic an aspecific ileocaecitis from common bacteria. Subsequently, because of granulomas and caseosis, the bowel wall appears heterogeneous and hypoechoic (see Figure 4a) with loss of normal stratification. Thickening (thickness up to 15mm) is uniform and concentric as opposed to the eccentric thickening at the mesenteric border found in Crohn’s disease or the marked irregular appearance of malignancy. Lymphadenopathy may be discrete or conglomerated (matted). The hypoechoic echotexture and the rounded shape (see Figure 4b) can mimic abdominal lymphoma. In tuberculosis the mesenteric, caeliac, porta hepatitis and peri-pancreatic nodes are characteristically involved, reflecting the lymphatic drainage of the small bowel. The retroperitoneal nodes (i.e., the periaortic and pericaval) are relatively spared, and are almost never seen in isolation, unlike lymphoma. Ascites is present in 40% of the cases and may be free or loculated ('honeycomb'-like appearance) (see Figure 4c). Fluid collections in the pelvis may have thick septa and can mimic ovarian cyst. Abdominal computed tomography (CT) clearly shows all the above-described US findings and accurately detects, by contrast enhancement, some specific signs, such as caseosis in the central portion of the lymph nodes as well as mesenteric and omental phlegmosus. However, even

**Figure 1: Schematic Drawing of Ultrasound Scan of Bowel**

A, B: Axial and transverse ultrasound scans of the last ileal loop. Marked mural thickening of the bowel wall mainly involving the mucosa (M) and the submucosa (S). The muscular layer is normal. The peri-ileal tissue is hyperechoic because of oedema and inflammation.

**Figure 2: Lower Right Abdominal Quadrant Ultrasound Scans in a Patient with Salmonella Group D Enteritis**

A, B: Axial and transverse ultrasound scans of the last ileal loop. Marked mural thickening of the bowel wall mainly involving the mucosa (M) and the submucosa (S). The muscular layer is normal. The peri-ileal tissue is hyperechoic because of oedema and inflammation.

**Figure 3: Lower Right Abdominal Quadrant Ultrasound Scans in a Patient with Thyphoid Fever**

A, B: Axial and transverse ultrasound scans of the last ileal loop. Marked mural thickening of the bowel wall mainly involving the mucosa (M) and the submucosa (S). The muscular layer is normal. The peri-ileal tissue is hyperechoic because of oedema and inflammation.
C: Pseudomembranous organisation of exudate in tuberculous ascites often shows a multiloculated aspect ('honeycomb'-like appearance).

**Antibiotic-associated Diarrhoea and Pseudomembranous Colitis**

Antibiotic-associated diarrhoea (AAD) occurs in about 5–30% of patients either early during antibiotic therapy or up to two months after the end of the treatment. Clinical presentations of AAD range from mild diarrhoea to fulminant pseudomembranous colitis. The latter is characterised by a watery diarrhoea, fever (in 80% of cases), leukocytosis (80%) and the presence of pseudomembranes on pathological gross specimens and endoscopic examination. Treatment with metronidazole and vancomycin is usually effective. If not treated promptly, severe complications including toxic megacolon, perforation and shock can occur, resulting in significant morbidity and mortality.

In moderate to severe cases, a diffuse or segmental thickening of the colonic wall is present at US. The wall of the affected colon is markedly thickened, hypoechoic and heterogeneous, causing narrowing of the lumen (see Figures 5a and 5b). Ascites are present in 50–80% of cases. The degree of colonic wall thickening is more marked in pseudomembranous colitis than with most other causes of colitis. Because other entities including ischaemic and infectious colitis may produce similar imaging findings, the clinical setting and stool cultures are helpful in establishing the correct diagnosis. Detection of *Clostridium difficile* toxins in the faeces is considered the gold standard for diagnosis. However, the toxin can be found in many asymptomatic adult subjects taking antibiotics and in up to 50% of healthy neonates. Barium X-ray studies usually show aspecific signs since the ‘thumb printing’ sign and nodular pattern of the mucosal surface are present only in late phases. Colonoscopy can show a specific mucosal pattern of pseudomembranes; however, it can be poorly tolerated by many with acute colitis. CT and US, by showing marked bowel wall thickening, mucosal nodular pattern and sometimes the more specific pattern of the ‘accordion sign’ in patients with suggestive clinical history, can offer a reliable diagnosis of antibiotic-associated colitis and justify a prompt start to metronidazole and vancomycin therapy. US is also a valuable tool for follow-up of these severely ill patients.

**Necrotising Colitis, Typhlitis (Neutropenic Colitis) and Pneumatosis Intestinalis**

Neutropenic colitis (also known as typhlitis) and acute necrotising enteritis occur in severely immunocompromised patients, characterised by thrombosis of intestinal wall vessels and necrosis that leads to oedema, thickening, mucosal ulcerations and eventual perforation. Intestinal wall necrosis may result in intraluminal bacterial gas entering the bowel wall (pneumatosis intestinalis) due to increased mucosal permeability caused by defects in the bowel wall. The ileum and caecum are most commonly involved in typhlitis and necrotising enterocolitis, but the remaining colon and distal ileum may also be affected. Neutropenic typhlitis has a mortality rate of 50–100%. The finding of pneumatosis intestinalis in this clinical context must be considered a poor prognostic sign.

Sonography is a rapid, non-invasive means for the detection of a thick-walled caecum and ascending colon in these patients. The colonic wall echotexture is usually hypoechoic and heterogeneous, with loss of the common distinct layers. It has been demonstrated that the degree of thickening is a valuable prognostic factor that adversely affects the outcome. The sonographic detection of increased colonic wall thickening (>4mm) two–four days after the end of intensive chemotherapy in neutropenic (neutrophils below 0.5x10⁹/l) patients with a clinical syndrome characterised by fever, diarrhoea and abdominal pain, confirms the clinical diagnosis of infectious neutropenic enterocolitis. In particular, it has been proposed that those patients with thicker bowel...
wall (>10mm) should receive intensive supportive treatment.62 Sonography is also an important tool in monitoring these patients in the intensive care setting.64 Pneumatosis intestinals has been described at US as the presence of echogenic foci in the thickened intestinal wall, better detected with high-frequency probes.69–70 This finding must be differentiated from artefacts mimicking pneumatosis.71 In doubtful cases a more specific tool, such as CT, must be used to confirm the diagnosis.71

Amoebic Colitis
Colonic infestation from Entamoeba histolytica can result in asymptomatic to mild or moderate colitis to fulminant colitis.82 At US, marked thickening of the bowel wall with, specifically, thickening of the submucosal layer have been described. A mild to moderate colonic thickening can be observed also in asymptomatic patients with positive stool for amoebic cysts and trophozoites.83 Metronidazole treatment is rapidly and lastingly effective.84 Since an unsuitable corticosteroid therapy may precipitate a life-threatening manifestation of intestinal amoebiasis as fulminant colitis, an ‘ex adjuvantis’ attempt with metronidazole therapy is indicated when the patient’s history suggests the possibility of amoebic aetiology.

Gastrointestinal Infections in the Immunodepressed Host
In acquired immunodeficiency syndrome (AIDS), when T4 cell depletion is marked (CD4 <400/mm³), gastrointestinal infections by opportunistic agents, which only rarely cause infections in immunocompetent hosts, can occur.85,86

Cytomegalovirus (CMV) infection represents 13% of the gastrointestinal tract infections in AIDS patients. It often causes death and frequently represents the first clinical sign of HIV disease (in up to 25%).86–88 In AIDS patients the colon is the main target of CMV. In CMV colitis the extent of the disease is very variable; most frequently the recto-sigmoidal and caecum-ascending colon tract are involved, often associated with involvement of the terminal ileum (typhilitis or ileocolitis pattern).89 Lesions located in short tracts of colon (especially rectus, sigma and right colon) may mimic tumour-like patterns (CMV pseudotumour).90 However, pancolitis patterns, mimicking pseudomembranous colitis, are also reported.90 Also, ‘skip areas’ have been described in 20% of cases.91 The US findings of intestinal affected segments include a marked and concentric mural thickening (even >30mm; median 15mm), with target appearance. In later stages, granulomatosis and deep ulcers caused by vasculitis and ischaemic phenomena produce an irregular, hypoechoic, heterogeneous pattern of colonic wall.92 Thickening and hyperrechogenicity of pericolic and mesenteric fat are always associated, whereas abdominal lymph node enlargement is infrequent. Ascites is present in 40–50%.

Early aetiologic diagnosis of CMV colitis is very important since effective (70–80% of cases) antiviral therapies (ganciclovir) are available. X-ray, US and CT and even endoscopy may not allow differential diagnosis in comparison with other infectious enteroctils, also frequent in AIDS patients. In focal forms, the signs of pericolic phlogosis allow a differential diagnosis between CMV pseudotumour, Kaposi’s sarcoma and non-Hodgkin lymphoma.90,92,93 Serological tests can have anamnestic value. Early and certain diagnosis must be obtained by means of histologic endoscopic examination, which shows the typical phlogistic pattern with giant cells and intranuclear inclusions by CMV.92,93

In AIDS patients, herpes simplex virus (HSV) can cause very serious infections with ulcers of the oral cavity, oesophagus, colon and, moreover, ano-rectum.92 At US, herpetic proctosigmoiditis shows thickening and a hypoechoic pattern of both the rectum and terminal tract of sigmoid walls.8 Surrounding soft tissues are strongly hyperechoic, because of perivascular phlogosis. Transvesical abdominal US with a 5MHz probe or transperineal US can describe the extension of inflammation towards superior tracts of colon. The most frequent cause of opportunistic bacterial infections in AIDS patients is mycobacterium avium complex (MAC).94,95 The segments most frequently interested are jejunum and ileum.95 US can demonstrate thickening and increased reflectivity of the jejunal plica and ileum submucosa,96,97 swelling and hyperrechogenicity of mesenteric and retroperitoneal lymph nodes,98–100 thickening and hyperrechogenicity of mesentery, and also hepatosplenomegaly with multiple small parenchymal abscesses, usually very numerous in the spleen.100 The abscess size can be below 3.5MHz probe resolution, so that only with high-frequency probes is it possible to have a reliable estimate of the number and extension of the abscesses.101 Definitive diagnosis must be obtained by US-guided fine needle aspiration biopsy, either of a lymph node or a liver/splenic abscess, which always shows numerous acid-alcohol resistant bacilli.99,101,102


