Eosinophilic Gastroenteritis with Appendix Involvement: Role of Intestinal Ultrasound

Roberto Bertè, Pietro Soru, Maurizio Vecchi and Mirella Fraquelli *

Gastroenterology and Endoscopy Unit, Fondazione IRCCS Ca’ Granda, Ospedale Maggiore Policlinico, University of Milan, 20122 Milan, Italy; roberto.berte90@gmail.com (R.B.); soru.pietro@gmail.com (P.S.); maurizio.vecchi@unimi.it (M.V.)

* Correspondence: mfraquelli@yahoo.it; Tel.: +39-02-5503-3369; Fax: +39-02-5032-0410

Received: 28 December 2018; Accepted: 8 March 2019; Published: 13 March 2019

Abstract: Eosinophilic gastroenteritis (EG) is a rare condition characterized by patchy eosinophilic inflammation of one or more layers of the gastrointestinal tract with no secondary causes of eosinophilia. EG is a treatable disease and, generally, patients show a positive response to steroid therapy. Sometimes the disease can present as acute abdomen, and appendicular involvement has seldom been described in the course of EG. In our case report we aimed to emphasize how useful gastrointestinal ultrasound is as a valuable tool for diagnosing and monitoring intestinal involvement during EG, avoiding invasive tests and unnecessary surgery.

Keywords: eosinophilic gastroenteritis; bowel ultrasound; appendicular involvement

1. Introduction

Described for the first time in 1937 by Kaiser [1], eosinophilic gastroenteritis (EG) is a rare condition characterized by patchy eosinophilic inflammation of one or more layers of the gastrointestinal (GI) tract with no secondary causes of eosinophilia. Clinical symptoms are not specific and differ according to the site, extension, and layer of the GI wall involved [2,3]. Most commonly, the GI tracts affected are stomach and duodenum [4].

Appendicular involvement of EG is rare and usually characterized by acute onset with a high rate of surgery [5,6]. The diagnosis is based on clinical presentation with abdominal pain, particularly in the inferior right quadrant, demonstration of eosinophilic infiltration of the appendicular wall, exclusion of other causes of peripheral eosinophilia, and absence of extra-intestinal diseases [7].

Intestinal ultrasound (IUS) represents a validated technique for the diagnosis and follow-up of several acute and chronic intestinal diseases, including acute appendicitis. Its bedside use has increased in emergency departments, reducing the need for more expensive radiological techniques, such as computed tomography scan (CT) [8]. Given its feasibility, tolerability, safety, and widespread availability, the application of IUS in the case of eosinophilic appendicular involvement in EG may play an interesting role in the diagnostic work-up and follow-up of this rare condition.

In our case report we aimed to emphasize the role of intestinal ultrasound as a valuable tool in diagnosing and monitoring intestinal involvement in EG, avoiding invasive tests and unnecessary surgery.

We have reported the case of a young man with sub-acute eosinophilic appendicular involvement, for whom IUS had a remarkable role in the clinical work-up and subsequent follow-up.

2. Case Report

A 24-year-old man (L.C.) was admitted to our emergency room with lower abdominal pain, dyspepsia, and spontaneous 5-kg weight reduction (BMI 22.8 to 21.3). These symptoms had started in...
the previous months, with no association with fever, vomiting, or diarrhea. Salmonellosis (6 months earlier) was the only issue in his medical history. Neither drug assumption nor allergies were reported. The patient denied any recent travel abroad or raw food consumption.

On admission, the patient’s blood pressure, oxygen saturation, and heart and respiratory rate were normal. Physical examination revealed mild-severe abdominal tenderness in the lower and right quadrant.

Blood tests showed an elevated white blood cell (WBC) count (19,000/mm$^3$), with normal hemoglobin, coagulation indices, and liver and renal function. Differential leukocyte formula was unavailable on admission.

An abdominal ultrasound was performed, with evidence of mild hepatosplenomegaly and an a-peristaltic, incompressible, dilated cecal appendix with wall thickness >6 mm with evidence of the “target sign”. These ultrasound features were consistent with mild appendicitis involvement.

Because of his refusal to be hospitalized, the patient was discharged with antibiotic therapy based on a 7-day amoxicillin/clavulanic-acid regimen.

Two days later he came back to our emergency room with persistence of symptoms and onset of non-bloody diarrhea (5–6 bowel movements per day). Vital signs and physical examination were normal, as were ECG and abdomen X-ray. Blood tests revealed an elevated WBC count with absolute eosinophilia (19,960/mm$^3$; EOS 10,470/mm$^3$). An empiric antibiotic regimen with ciprofloxacin and metronidazole was prescribed. A few days later, because of the persistence of severe abdominal pain in the lower quadrant, a contrast-enhanced CT scan was performed, revealing multiple reactive lymph node enlargement and excluding acute appendicitis or abdominal masses. The patient was then admitted to a medical unit. Infectious enteritis being suspected, stool cultures for *Shigella*, *Salmonella*, *Campylobacter*, *C. difficile* antigen, *E. coli O157:H7*, *Yersinia* spp., *Strongyloides*, *Toxocara*, *Cryptosporidium* were carried out and tested negative. The test for serum *Schistosoma*, *Amoeba* spp. and HIV antibodies was negative. Given the presence of multiple mesenteric lymphadenopathy in the CT scan, immunophenotyping by flow cytometry was performed on peripheral blood, revealing no phenotypic alterations of B/T-lymphocytes.

Despite the patient always denying any upper respiratory tract symptoms, chest X-ray and ANCA (antineutrophil cytoplasmic antibodies) screening were carried out in order to rule out eosinophilic granulomatosis with polyangiitis, and they tested negative.

A progressive reduction of bowel movements and normalization of the WBC count were observed during the antibiotic treatment, albeit the persistence of absolute eosinophilia. Esophagastroduodenoscopy and colonoscopy were proposed, but the patient refused.

He was then discharged with the indication to continue the diagnostic work-up as an outpatient and to have his blood monitored.

The recurrence of abdominal discomfort in the right lower quadrant associated with a new rise of the eosinophilic count (WBC 12,800/mm$^3$, EOS 6200/mm$^3$) was observed 8 weeks after the first admission. The patient was then admitted to our gastroenterology department. The detection of HTLV antibodies, anti-Anisakis IgE, and screening for ANA, ENA, and ANCA tested negative. Serum IgA, IgG, IgM, C3, and C4 were measured and resulted within the normal range.

All the infection tests, including stool cultures for bacteria and parasites, were repeated and tested negative, thus excluding any infective causes of hyper-eosinophilia. Therefore, in order to rule out chronic eosinophilic leukemia, mutations of FIP1L1-PDGFRA were searched for and tested negative.

In the GI ultrasound, the jejunal and ileal loops appeared slightly dilated with increased liquid or slightly echoic content (Figure 1). Reactive mildly enlarged mesenteric lymph nodes (maximum diameter 10 × 5 mm) were still present. In the right lower quadrant, a thickened hyper-vascularized appendix (maximum diameter: 6.9 mm) was evidenced (Figure 2), surrounded by hypertrophic activated mesentery and a small amount of free abdominal fluid (arrow). The patient (L.C.) gave his consent for the publication of information about his case, as contained in the present case report.
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**Figure 1.** Transverse real-time ultrasound scan of the bowel performed with a high-frequency transducer (5–12 MHz), showing moderately dilated bowel loops with a slightly thickened bowel wall and increased moderately echoic luminal content.

**Figure 2.** Transverse real-time ultrasound scan of the right lower quadrant performed with a high-frequency transducer (5–12 MHz), showing appendix involvement in EG with thickening of the wall, target sign, diameter >6 mm, hyperemia of the wall, and surrounding free fluid.

An ileocolonoscopy was performed and showed a highlighted, white-speckled lesion next to the appendicular orifice. Well-oriented endoscopic biopsies of the whole tracts being explored were collected.

An esophagogastroduodenoscopy was also performed and showed a macroscopically normal pattern; multiple biopsies were obtained against the suspicion of eosinophilic gastroenteritis.

Histological examinations showed a remarkable eosinophilic infiltration in the duodenal (35–50 eosinophils/HPF), ileo-cecal (60 eosinophils/HPF), and colonic (25–30 eosinophils/HPF) mucosa.

These findings confirmed our clinical suspicion of eosinophilic gastroenteritis on the basis that, according to the pathologist expertise in our hospital, the diagnostic cut-off values for the diagnosis of EG are as follows: 35–40 eosinophils/HPF in the duodenum, 40 eosinophils/HPF in the ileum-cecum, and 25–30 eosinophils/HPF in the rest of the colon.
We prescribed a glucocorticoid regimen based on prednisone 30 mg/die, with the indication of rapid and progressive tapering during the following two weeks. The eosinophilic count rapidly decreased and gastrointestinal symptoms disappeared. The patient was discharged.

Gastrointestinal US was repeated at the end of the steroidal therapy, with evidence of a normalized appendicular diameter (5.5 mm), persisting mild hyper-vascularization, and reduction of adjacent free fluid.

After 8 weeks from the discontinuation of prednisone, a new US was performed with evidence of complete resolution of the appendicular inflammation and disappearance of all pathological findings (Figure 3a,b).

![Figure 3](image-url) **Figure 3.** (a) Longitudinal and (b) transverse real-time ultrasound scan of the right lower quadrant performed with a high-frequency transducer (5–12 MHz), showing the complete resolution of appendicular inflammation with disappearance of any free abdominal fluid.
A maintenance therapy with a budesonide-based regimen was prescribed (starting at 9 mg). Good control of symptoms and reduction of the eosinophilic count was achieved, with progressive steroid tapering to 3 mg/day. Because of the chronic adverse effects of steroidal therapy, as particularly observed in long-term therapy, an attempt with ketotifen was chosen and is actually ongoing. The patient is currently symptomless and blood tests, including the eosinophil count, are normal.

3. Discussion

Eosinophils are pro-inflammatory leukocytes primarily present in the lamina propria of all the GI tract, except for the esophagus, with a rate of 20–30% of the cellular population [4,9]. Their concentration in the mucosal layer varies between the different sites of the GI tract and also according to patient characteristics, such as age, climate, and diet [2].

EG is a rare disease that can affect both children and adults, with a prevalence recently reported to vary from 7/100,000 [10] to 28/100,000 people depending on the site and age of onset [11,12]. The diagnosis is based on the presence of gastrointestinal symptoms, histologic samples demonstrating eosinophilic infiltration of the gastrointestinal tract, and absence of extra-intestinal disease (i.e., parasitic infections, food hypersensitivity, drug reactions, malignancies, inflammatory bowel disease, celiac disease, and vasculitis) [13].

Abdominal pain, nausea, weight loss, and fever are non-specific signs of the disease and are often present, although the clinical presentation depends on the gastro-intestinal wall layer involved. Three different patterns of disease have been described: mucosal (70%), muscular (20%), and serosal (10%) [3]. Frequently, more layers are involved. In the mucosal/submucosal disease, anemia from occult or manifested GI bleeding, diarrhea or protein-losing enteropathy are often observed. Intestinal obstruction and ascites are rarer complications secondary to muscular or serosal involvement, respectively [10]. The course varies from a single flare to recurring or continuous disease [14].

Peripheral eosinophilia is present in about 80% of the cases [10,15,16], although it is not specific to EG. It does not correlate with the activity of the disease or histological healing; thus, it is not very useful for follow-up [17]. Other non-specific features include anemia, increased inflammation indices, and severe malabsorption [2,10].

There are no specific imaging signs of EG. In most case reports, CT scan is the technique of choice [18–21]. As in its clinical presentation, the CT features of EG also vary according to the different layers of the GI tract involved: ulcers and polyps in the mucosal pattern, strictures and thickening in the muscular pattern, and ascites and omental involvement in the serosal pattern [10].

Endoscopy is useful, particularly in the case of mucosal involvement. Upper and/or lower endoscopy can show mucosal damage [2], such as erosions, whitish speckles, polyps, ulcers, or stenosis, and allows tissue sample collection for histological examination, which represents the gold standard for diagnosis. Usually biopsies are recommended in all the mucosal lesions identified and in all the GI tract examined, because of the patchy involvement of the disease [10]. Biopsies of the bowel wall by means of laparotomy [22] can be performed in case of presentation of serosal patterns, and for diagnostic paracentesis [23,24].

As for the aforementioned variations of the tissue eosinophilic count, there is no consensus with regard to the histological diagnosis, except for the eosinophilic esophagitis where a cut-off value of 15 eosinophils per high-power field (HPF) is defined [25]. Recent evidence quotes the following eosinophilic tissue cut-off values as diagnostic: >30 eosinophils per high-power field in the stomach, >52 in the small intestine, >50–100 in the right colon, >35–84 in the transverse colon, and >25–65 in the left colon [26–28].

The correlation between food assumption and EG has led to the empirical food-elimination diet as the first therapeutic effort, given its good effectiveness in children with 75% remission rates [29,30]. No data on adult populations is available because of low compliance, especially over an extended period of time.
Corticosteroids remain the mainstay of medical therapy for patients who fail or do not tolerate a dietary approach [10,31,32], thanks to their activity as inhibitors of eosinophil growth factors, such as IL3 and IL5 [33]. An initial dose of prednisone 20–40 mg/day for 6–8 weeks achieves symptom regression in 90% of patients [34]. For patients with a relapsing disorder, treatment with budesonide has shown good tolerability and efficacy in controlling symptoms, together with an important reduction of systemic side effects [35].

For patients with steroid-dependent disease, the use of immunomodulators (azathioprine 6-mercaptopurine), leukotriene-receptor antagonists (i.e., montelukast), antihistamine medication (ketotifen), and biological agents (omalizumab; mepolizumab) has shown good efficacy in order to achieve long-term remission in small-size case series [15,33].

The use of ultrasound for the diagnosis and follow-up of eosinophilic gastroenteritis is documented [36–39] but still limited.

The most frequently reported signs in IUS [36–39] are related to the different intestinal layers involved. Several pictures are described. One can find a moderate dilation of bowel loops showing mild-to-moderate bowel wall thickening starting from the stomach to the terminal ileum. Bowel wall stratification can be lost and the wall can be hyper-echoic with hypertrophy of valvulae conniventes. The luminal content can be either brilliant (in the case of corpuscular content) or completely anechoic (in the case of liquid content). Mild free fluid within the bowel loops is frequently present and, if abundant, it should be sampled to demonstrate the presence of eosinophilic ascites, characterized by a high eosinophilic count. Intestinal intussusception, an extremely rare complication of eosinophilic gastroenteritis, can also be documented by IUS [40]. Previous reports have shown the utility of IUS for pediatric patients [38] who present with abdominal symptoms, since the technique is rapid, cheap, and non-invasive and provides useful diagnostic information. Being easily repeatable, IUS is particularly useful in a patient’s follow-up, as it has been reported to be particularly useful in the detection and post-treatment follow-up of several intestinal diseases.

Regarding our patient, in addition to ileac involvement, which is a quite common finding in EG, IUS also documented appendicular involvement.

The utility of IUS is well known as first-line imaging for the diagnosis of acute abdomen as in the case of inflammatory involvement of the appendix. In acute appendicular inflammation, the most frequent US signs reported [41] are increased bi-parietal diameter (>6 mm) or single wall thickness (≥3 mm) with hyper-vascularity and incompressibility. The “target sign” is a pathognomonic sign, consisting in the involvement and thickening of whole layers of the appendicular wall. Free abdominal fluid, increased echogenicity of the local mesenteric fat, and local lymphadenopathy are often present.

Appendicular carcinoid, which is a well-differentiated neuroendocrine tumor, was also a possible differential diagnosis, as it sometimes presents with an acute onset, mimicking acute appendicitis. However, in our case, its presence was excluded on the basis of both imaging (absence of mass within the appendicular wall) and laboratory findings (presence of intestinal and peripheral eosinophilia) and, most importantly, the remission after immunosuppressive therapy.

Acute abdomen is a possible manifestation of EG [36] and appendicular involvement has sporadically been described as leading to unnecessary surgery in most cases [5,34,36]. Furthermore, surgical case series reported a 16.7% rate of recurrent symptomatic intestinal eosinophilia after appendectomy [42,43].

There is no clear data about the timing and modalities of follow-up for EG, particularly in the case of appendicular involvement, given the rarity of this condition.

Regarding our patient, the use of gastrointestinal ultrasound proved useful to corroborate the diagnostic suspicion of the disease and also to assess the response to steroidal therapy and subsequent resolution of appendicular inflammation, with no need for more expensive or invasive techniques. Surgery was avoided, thanks to the evidence of both clinical and ultrasound improvement during follow-up.
In the presence of acute abdominal symptoms associated to hyper-eosinophilia, EG should be suspected and GI ultrasound can be a very useful tool for strictly monitoring patients and sparing them unnecessary more invasive tools or surgery.

**Author Contributions:** Conceptualization: R.B., P.S., M.F.; Data curation: R.B.; Investigation: P.S.; Supervision: M.V. and M.F.; Writing—original draft: R.B. and P.S.; Writing—review & editing: M.F.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The authors declare no conflict of interest.

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