Colon capsule endoscopy compared with other modalities in the evaluation of pediatric Crohn's disease of the small bowel and colon

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Background and Aims: Data on colon capsule endoscopy (CCE) in evaluating the small bowel and colon concurrently are rare. This study aimed to evaluate the accuracy of CCE in assessing disease activity of the small bowel and colon in pediatric Crohn's disease (CD) by comparison with magnetic resonance enterography (MRE), small-intestine contrast US (SICUS), and ileocolonoscopy.

Methods: We prospectively enrolled 40 consecutive patients (22 male, 18 female, mean age 13.1 ± 3.1 years) with CD of the small bowel and colon. All underwent SICUS, MRE, CCE, and ileocolonoscopy sequentially over 5 days. All investigators were blinded to patient history and test results. Patients were classified as active or inactive for the small bowel and the colon according to specific criteria for each tool (simple endoscopic score for CD, Lewis score, US and magnetic resonance parameters of activity). For colon mucosa evaluation, ileocolonoscopy was the comparator. For the small bowel, a consensus panel was convened.

Results: Sensitivity of CCE to detect colon inflammation was 89%, and specificity was 100%. The positive predictive value (PPV) and negative predictive value (NPV) of CCE for colon inflammation were 100% and 91%, respectively. In the small bowel, CCE showed 90% sensitivity, 94% specificity, with PPV and NPV of 95% and 90%, respectively. Accuracy parameters for SICUS (sensitivity 90%, specificity 83%) and MRE (sensitivity 85%, specificity 89%) were lower than those for CCE. No serious adverse events related to the CCE procedure or preparation were reported.

Conclusions: CCE is of great usefulness in evaluating both small bowel and colon mucosa in pediatric CD. This single, noninvasive tool makes it possible to evaluate the small-bowel and the colon concurrently with high diagnostic accuracy. Future multicenter studies need to define the role of CCE in the routine management of pediatric patients with CD. (Clinical trial registration number: NCT02199626.) (Gastrointest Endosc 2016;83:975-83.)

Crohn's disease (CD) is a chronic inflammatory disorder that can affect all or part of the GI tract with heterogeneous manifestations and adverse events.[1,2] In the past, CD treatment was largely dictated by clinical parameters alone. Treatment objectives have now shifted to include mucosal healing, which correlates with decreased hospitalization and surgery rates.[3]

The criterion standard for assessing mucosal inflammation is colonoscopy, but this is impractical for regular monitoring, especially for pediatric patients. The need for repeated anesthesia or deep sedation warrants a less-invasive means of assessment.[4] Moreover, 70% of pediatric CD involves the small bowel, and the disease, at least initially, is limited to the small bowel in as many

Abbreviations: AFR, adaptive frame rate; CCE, colon capsule endoscopy; CD, Crohn's disease; IBD, inflammatory bowel disease; MRE, magnetic resonance enterography; NPV, negative predictive value; PEG, polyethylene glycol; PPV, positive predictive value; SICUS, small-intestine contrast US.

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as 30% of children with CD.[5,6] The ability to accurately assess the small bowel together with the colon would seem to present a more complete understanding of CD activity and better determine optimal patient management.[3]

Capsule endoscopy,[7,8] magnetic resonance enterography (MRE), and US contribute different views of the intestine and surrounding structures as they describe inflammation in pediatric CD.[9,10] Recently, our group described the usefulness of colon capsule endoscopy (CCE), in evaluating disease activity in pediatric ulcerative colitis.[11] Because CCE also acquires images of the small bowel at a rate similar to that of current-generation small-bowel capsules, we hypothesized that CCE would offer the same, or even higher, accuracy in evaluating the small intestine in addition to its ability to explore the entire colon. Based on this background, we performed this prospective study on the diagnostic accuracy of CCE compared with other modalities in evaluation of pediatric patients with small-bowel and colon CD, also calculating the interobserver agreement between physicians in order to assess reproducibility of the technique.

PATIENTS AND METHODS

Patients

Eligible patients were recruited at the Pediatric Gastroenterology and Liver Unit of the Sapienza University of Rome, a tertiary-care referral pediatric center for inflammatory bowel disease (IBD), between September 2013 and July 2014. Inclusion criteria were as follows: age 6 to 18 years, diagnosis of CD at least 3 months before enrollment, and need for endoscopy and imaging follow-up. Exclusion criteria were as follows: dysphagia, renal insufficiency, known stricturing CD identified by imaging tools, and prior abdominal surgery of the GI tract, other than uncomplicated procedures that would be unlikely to lead to bowel obstruction, based on the clinical judgment of the investigator. Disease activity was evaluated with the Pediatric Crohn's Disease Activity Index (Table 1).[12] Academic investigators designed, approved, and analyzed the study. All authors have reviewed the study data and approved the final manuscript. The study protocol was defined in accordance with the Declaration of Helsinki and approved by the ethics committee of the University Hospital Umberto I in Rome. Written informed consent was obtained from parents of all children; children aged >12 years signed a statement of assent. The trial has been registered on Clinical Trial.gov, NCT02199626.

All patients underwent SICUS, MRE, CCE, and ileocolonoscopy sequentially over 5 days (Fig. 1). Patients unable to submit to any of the 4 diagnostic techniques (ie, suspected strictures identified by the imaging tools and before endoscopy) were excluded. Coinvestigators were blinded to patient history and all test results.

TABLE 1. Patient demographic characteristics and clinical information

Patients	N = 38
Age, median (range), y	13.1 (8-18)
Sex, male, female	22, 18
Prior known disease location, no. (%)	
L1	8 (21)
L2	10 (26)
L3	16 (42)
L4a	2 (5)
L4b	13 (34)
Disease duration, median (range), mo	37.3 (5-96)
Age at diagnosis, median (range), y	11.8 (7-16)
Previous medications, no. (%)	
Anti-inflammatory drugs	11 (29)
Immunomodulators	19 (50)
Biologics	14 (37)
No therapy	4 (11)
Clinical activity, PCDAI, no. (%)	
Inactive	19 (50)
Mild to moderate	10 (26)
Severe	9 (24)

L, Location; *PCDAI*, pediatric Crohn's disease activity index.[12]

Imaging studies

SICUS and MRE were performed (Table 2) with the techniques and criteria for CD previously reported.[9,13-15]

Bowel preparation

The day before the endoscopic examinations, clear liquids were given together with 50 mL/kg (up to 2 L) of polyethylene glycol (PEG) solution to drink. On the day of endoscopy, 50 mL/kg (up to 2 L) of PEG was given at 7:00 AM. Each patient swallowed a CCE at 8:00 AM, and if the capsule remained in the stomach >1 hour, 0.25 mg/kg of domperidone was administered in order to stimulate gastric emptying. Once the CCE exited the stomach and detected small bowel, certified by the real-time viewer, a first booster of oral sodium phosphate solution (30 mL) was given. A second booster of sodium phosphate (15 mL) was given 3 hours later. These doses were designed to promote distal movement of the capsule through the bowel and to improve capsule excretion. One bisacodyl suppository (10 mg) was given to facilitate bowel emptying and excretion of the CCE, if necessary, 3.5 hours after the second booster (Table 2). For patients in whom the capsule was not excreted before 8 PM, fasting was continued and 25 mL/kg of PEG with intravenous hydration were administered.

Endoscopy

The CCE examination preceded ileocolonoscopy. Both procedures were recorded. After ingestion of the capsule,