Capsule Endoscopy Versus Enteroclysis in the Detection of Small-Bowel Involvement in Crohn's Disease: A Prospective Trial

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Background & Aims: **The aim of this study was to prospectively compare the diagnostic yield of wireless capsule endoscopy (WCE) and enteroclysis in evaluating the extent of small-bowel involvement in Crohn's disease (CD).** ***Methods:*** **Thirty-one patients (20 men; mean age, 43 y) with endoscopically and histologically proven CD underwent enteroclysis as their initial examination, followed by WCE. The radiologist who performed the small-bowel enema was blinded to the results of standard index endoscopy, which included retrograde ileoscopy. Gastroenterologists were blinded to the results of enteroclysis at the time of interpretation of the WCE video.** ***Results:*** **Abnormal findings were documented in 8 of 31 patients by using enteroclysis and in 22 of 31 patients by using WCE (25.8% vs. 71%, $P < .001$). In 16 patients with known involvement of the terminal ileum, the diagnostic yield of WCE vs enteroclysis was significantly superior (89% vs 37%, $P < .001$). In 15 patients without lesions in the terminal ileum, abnormal findings in the proximal small bowel were detected in 7 (46%) patients by WCE and only in 2 (13%) patients by enteroclysis ($P < .001$). The capsule detected all but 2 lesions diagnosed by enteroclysis. WCE detected additional lesions that were not detected by enteroclysis in 45% of cases.** ***Conclusions:*** **WCE is superior to enteroclysis in estimating the presence and extent of small-bowel CD. WCE may be a new gold standard for diagnosing ileal involvement in patients with CD without strictures and fistulae.**

Crohn's disease (CD) is a systemic, segmental, chronic granulomatous disease that may involve any part of the alimentary tract. The small bowel is affected frequently, in approximately 30%–40% of cases.[1] Diagnosis of CD arises from a constellation of clinical, endoscopic, radiographic, and histologic findings rather than a single test. The correct evaluation of the extension of CD is crucial to the identification of different subgroups of patients,[2] allowing for tailored management. It generally is accepted that the current visualization and imaging methods available to the gastroenterologist in diagnosing small-bowel diseases and disorders are unsatisfactory.[3] The need for enhanced endoscopic examination of the small bowel, particularly for evidence of inflammatory disease, is well recognized.[4,5] Double-contrast enteroclysis (EC) is regarded universally as the gold standard for demonstration of small-bowel lesions in CD.[6] Computed tomography EC proved highly accurate in detecting involvement of the terminal ileum.[7] Other imaging methods provide limited contribution. The alternative solution should be relatively comfortable for the patient, easy to use by the gastroenterologist, relatively inexpensive, and one that will provide a reasonable level of visual imaging for the detection of small-bowel abnormalities. The M2A Capsule (Given Imaging, Yoqneam, Israel) is a new modality of imaging the entire small bowel.[8,9] It is a radiotelemetry capsule videoendoscope that is small enough to be swallowed and has no external wires, fiberoptic bundles, or cables. Initial prospective trials support the role of wireless capsule endoscopy (WCE) as an improvement in the ability to assess and diagnose mucosal lesions in the small bowel.[10–13] WCE may define early disease involvement in areas of the small bowel, including the jejunum and proximal ileum, that traditionally have been less directly accessible.

This was a prospective study designed to compare double-contrast EC with capsule endoscopy in patients with CD. The primary aim of the study was to evaluate the diagnostic yield of WCE vs EC in assessing small-bowel

Abbreviations used in this paper: CD, Crohn's disease; EC, enteroclysis; WCE, wireless capsule endoscopy.

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involvement and extension, and the secondary aim was to evaluate any negative outcomes of the 2 procedures.

Materials and Methods

Patient Selection

This was a prospective controlled trial involving 4 hospitals of secondary and 1 of tertiary care. The investigation was approved by local institutional review boards, and each patient signed informed consent to participate in the study. Patients with symptoms suggestive of inflammatory bowel diseases (abdominal pain, diarrhea, constipation, hematochezia, fever, weight loss, anemia) underwent both esophagogastroduodenoscopy and total colonoscopy with retrograde ileoscopy, when feasible, at the same digestive endoscopy unit. If endoscopy showed a suspected CD, a double-contrast EC was performed to detect small-bowel involvement and to rule out strictures or fistulae. Diagnosis was confirmed in every case by histologic examination of biopsy specimens taken endoscopically in the colon and/or in the terminal ileum. All patients with a newly diagnosed CD were eligible for entry into the study. To guarantee adequate blinding among radiologists performing EC and gastroenterologists interpreting WCE, a third independent medical team enrolled the patients and assessed the presence of inclusion criteria. Exclusion criteria were age less than 18 years, pregnancy, patients already treated for CD, inability to reach the terminal ileum with the colonoscope, stenosing or fistulizing CD, implanted electromedical device, history of small-bowel surgery, lack of ability to swallow, nonsteroidal anti-inflammatory drug consumption 1 month prior, and human immunodeficiency virus positivity.

Radiologic Imaging

The evening before EC was performed, the bowel was prepared with 3 L of SELG-S (Promefarm, Rome, Italy) administered in 250-mL increments every 15 minutes. Double-contrast EC was performed according to the technique described elsewhere.[14,15] After transnasal intubation, the tip of an 8-F wire-guided duodenal catheter was advanced at the duodenojejunal junction. Once the tube end was placed, the barium first was infused manually (200–250 mL of an 80% wt/vol suspension), followed by methyl cellulose (1000–1500 mL of a .5% water solution). Radiographs were taken as prone and supine panoramic views and as distal ileum details under compression. All radiograph films were reviewed blindly by 2 independent radiologists (A.S. and O.C.) who were not aware of initial gastrointestinal tract involvement. The final decision on ileal involvement and extension was then achieved, resolving the disagreement on records. Fold thickening, aphthous ulceration, granular appearances of the villi, nodular pattern, the presence of ulcerations on the mesenteric border, cobblestone appearance, fixed stenosis and/or strictures, and fistulae were considered positive findings for ileal involvement. If stenoses and/or strictures and fistulae were observed, this was recorded and the patient was considered a WCE failure. If no stenoses and/or strictures and fistulae were observed, the patient then underwent WCE study with the M2A capsule.

Wireless Capsule Endoscopy Procedure

The M2A capsule measures 26.4 mm in length by 11 mm in diameter. The capsule emits a flashing light powered by 2 disk batteries and is propelled by peristalsis through the gastrointestinal tract. High-quality digital color images are recorded at 2 frames/s. Images are transmitted by digital ultra high-frequency–band radiotelemetry to an ambulatory data recorder that is worn on a belt around the patient's waist. The total recording time is dependent on battery life, which currently averages 8 hours. Consent was obtained from all patients for WCE. In an attempt to optimize visualization of the small bowel, on the evening before the capsule examination, patients underwent a mini-bowel preparation with 2 L of SELG-S (Promefarm) administered in 250-mL increments every 15 minutes. A belt containing the data recorder was positioned outside the anterior abdominal wall. After an overnight 12-hour fast, patients ingested the wireless videocapsule. They were allowed to drink 2 hours after ingesting the capsule and they were allowed to eat 4 hours afterward. After having ingested the capsule with a small amount of water, patients were free to go about their usual activities. The recorder functioned for 7–8 hours after ingestion. Patients were asked to verify the excretion of the capsule by retrieving it from their feces. If there was no evidence of capsule excretion within 3 days, all patients underwent an abdominal radiograph and the event was recorded as an adverse event or *capsule retention*. On completion of the examination, the recorder was removed and data were transferred to a computer workstation through a high-capacity digital link. Images were compressed into a digital video that was reviewed independently the following day by 2 experienced observers (R.M., G.R.) who were blinded to clinical data. The agreement regarding the ileal involvement and extension was evaluated. Adequacy of WCE examination and all complications were noted. Capsules were discarded on elimination in the stool.

Outcome Measures

Capsule results for each individual patient were evaluated by a panel of 2 clinicians to define an outcome measure for each study. White lesions within a crater and with surrounding erythema were classified as ulcers; superficial white lesions with surrounding erythema were characterized as erosions. Positive findings on the WCE recording were considered diffuse small-bowel lesions or multiple (>3) erosions or ulcers that were serpiginous, deep fissuring, coalescing, linear, or nodular. Nonspecific or negative was assigned to studies that showed no abnormalities or nonspecific findings (isolated erythematosus spots, villous dropout, enlarged folds, mucosal breaks).

Adequacy of Examination

Criteria considered to determine the adequacy of capsule evaluation included whether the capsule reached the ce-