

# Capsule endoscopy: Coming of age!

**Leighton JA, Helper DJ, Gralnek IM, Dotan I, Fernandez-Urrien I, Lahat A, *et al.* Comparing diagnostic yield of a novel pan-enteric video capsule endoscope with ileocolonoscopy in patients with active Crohn's disease: A feasibility study.**

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This article reports the results of evaluation of new PillCam pan-enteric capsule (small bowel colon capsule endoscopy [SBC CE], Medtronic) designed to image both small bowel and colon in patients with Crohn's disease (CD). The SBC capsule is a new capsule designed to image both small bowel and colon. It is a two-headed video capsule, similar to second-generation colon capsule in its hardware components, with a field of view of 172° in each head and a frame rate up to 35 frames/s that varies with the speed of capsule in the bowel. The aim of a single CE procedure will be to avoid multiple investigations for evaluation of the extent of disease involvement and activity in patients with CD.

In this prospective, multicenter study, the included subjects were adult patients (18–75 years) with active CD as suggested by elevated inflammatory markers, anemia, hypoalbuminemia, or weight loss. The study excluded patients with suggestion of decreased or blocked motility, comorbidities such as diabetes, renal disease, allergies, pregnancy, indeterminate or ulcerative colitis, concurrent nonsteroidal anti-inflammatory drug use, *Clostridium difficile* infection, and evidence or possibility of intestinal stricture. The patency of the gastrointestinal tract was assessed by patency capsule. Eligible patients underwent the procedure (SBC CE) after bowel preparation using polyethylene glycol preparation and also underwent ileocolonoscopy within 24 h of the same. Lesions were identified and labeled as representing active, or inactive CD with active lesions being identified if aphthous ulcerations, ulcers other than aphthous-like lesions, bleeding, or inflammatory stricture were present.

Of the 114 patients considered, 38 were excluded and eventually 73 underwent SBC CE and 71 underwent ileocolonoscopy. However, 66 patients completed both SBC and ileocolonoscopy procedures with analyzable results and therefore were included in the efficacy analysis. While the quality of bowel cleansing was similar for terminal ileum with both the modalities, i.e., SBC CE and ileocolonoscopy, the quality of colon cleansing was significantly worse when assessed with SBC CE. This was true for all areas of the colon from the cecum till the rectum.

Each subject's diagnostic yield rates for active CD were higher with SBC CE (83.3%) than with ileocolonoscopy (69.7%). In proximal small bowel (assessed only by SBC), 45% patients had active CD. Each segment diagnostic yield was 40.6% for SBC and 32.7% for ileocolonoscopy. The higher yield for active CD with SBC CE was true for all bowel segments. 14.9% of patients experienced procedure-related adverse events with the most common being nausea, abdominal pain, and vomiting and 3 (2.6%) patients required hospitalization. Of these three, one had CE-related bowel obstruction, another had abdominal pain after ingestion of patency capsule, and third had abdominal pain related to bowel preparation. Based on these results, the authors concluded that the pan-enteric SBC capsule may be a useful tool in identifying active CD in the small bowel and colon in subjects with active CD.

## Commentary

CE has emerged as an important armamentarium for evaluation of small bowel disease and helped open up the “dark continent of gastrointestinal tract” for evaluation.<sup>[1]</sup> However, recent advances have also brought about the utility of CE in evaluation of the esophagus and the colon. Colon capsule is an advancement which is helpful in situations when colonoscopy may not be feasible as with refusal of consent or incomplete examination or when colonoscopy is deemed to be a high-risk procedure. With cameras at both the ends, the colon capsule goes into a sleep mode after initial few minutes of activity. Thereafter, it takes images for 10 h permitting visualization of the colon. A second-generation colon capsule has an adjustable image acquisition rate which varies with the speed of progression of the capsule, thereby optimizing the use of battery and permitting complete colon examination. It also has automated small bowel identification feature.<sup>[2,3]</sup> These advances raise the hope of a pan-endoscopy becoming feasible with CE, and further technological enhancements must address this goal. Pan-endoscopy may find utility in evaluation of cause of abdominal pain, iron deficiency anemia, and gastrointestinal bleeding, disease extent in CD, search for a gastrointestinal primary in metastatic disease and evaluation of polyposis syndromes. Although some reports have indicated that extra-small intestinal or extra-colonic lesions may be visualized on small bowel and colon CE, respectively, detailed reports on pan-enteric visualization are limited.<sup>[4,5]</sup>

The SBC capsule, used in this paper, is a modification of the PillCam COLON 2 capsule. Interestingly, the diagnostic yield of SBC CE appeared to be higher in the present study vis-à-vis colonoscopy. However, by definition, the terminal ileum included all mucosa seen 10 min before cecum entry in CE and therefore may have included more length of the ileal segment, thereby confounding the comparison with terminal ileum seen on ileocolonoscopy. Furthermore, even while the

preparation was deemed to be better on ileocolonoscopy, the yield of active CD on SBC CE did not seem to suffer. The added benefit, of course, is the evaluation of the proximal small bowel for which CE is believed to be better than other available modalities.<sup>[6]</sup> In another recent report on 165 patients who underwent colon CE, findings in small bowel could be detected in 70% patients while pan-endoscopy was feasible in 86% cases. Of course, there are hindrances to the utilization of CE as a pan-enteric endoscopic tool. The complete visualization of the stomach is an issue, but use of magnetic manipulation may help in ensuring complete gastric visualization.<sup>[7]</sup> Apart from this, inability to sample and clean debris and to focus the area showing the lesion remain other inadequacies which need to be addressed. In addition, the issue of capsule retention and/or bowel obstruction needs to be addressed. However, there is no doubt that baby steps toward realizing the goal of a pan-endoscopy with capsule endoscopy are being taken.

**Gu H, Zheng H, Cui X, Huang Y, Jiang B. Maneuverability and safety of a magnetic-controlled capsule endoscopy system to examine the human colon under real-time monitoring by colonoscopy: A pilot study (with video).**

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This article reports about 57 volunteers who underwent magnetic controlled capsule endoscopy (MCCE) and colonoscopy. The study was a prospective study done at a Chinese center and included subjects who were chosen from the volunteers for colorectal cancer (CRC) screening. The MCCE system (Chongqing Jinshan Group, China) is a magnet-equipped capsule measuring 27.9 mm × 13 mm and has an external magnetic manipulator and image transmission system. The capsule used was an upgraded OMOM capsule (manufactured by the same company) with usual image acquisition at 2 frames/s. It has a sleep mode (1 frame every 8 s) which is enabled at during its movement in the small bowel and deactivated in the terminal ileum. The patients who underwent MCCE also underwent colonoscopy when the capsule reached the terminal ileum. This was to ensure real-time monitoring which was limited to 25 min. Maneuverability was defined as rotation, somersaulting, looking down and up of the capsule. Linear motion maneuverability (oral and anal) was also recorded.

Of 57 volunteers, 52 were included in the final analysis. The capsule reached the cecum in  $3.63 \pm 1.14$  h in all 52 volunteers and all of them were awakened successfully at the cecum. The maneuverability was recorded as good in 94.2% and moderate in 5.8% patients. Linear motion was possible in all subjects. MCCE identified six positive lesions, all of which

were confirmed on colonoscopy. No serious adverse events were noted.

## Commentary

Colonoscopy is the tool of choice for CRC screening and has proven to be of benefit in reducing CRC-related mortality.<sup>[8]</sup> Universal CRC screening however remains a distant goal due to different concerns such as incomplete colonoscopies, concerns regarding adverse events, and pain-related to colonoscopy.<sup>[9]</sup> Even when patients do undergo colonoscopy, lesions may be missed due to issues related to bowel preparation, small lesions, awkwardly located lesions, and operator-related issues.<sup>[10]</sup> The use of CE for CRC screening may have some benefits, including lack of pain (due to distension during colonoscopy), no need of expert operator, possibility of telemedicine, and lesser risk of perforation. However, to achieve clinical success in screening strategy, CE must be able to provide lesion detection similar to colonoscopy. This warrants determination of methods of adequate colonic preparation. In addition, maneuverability of capsule will further improve detection of lesions as it will allow visualization of all walls and possibly both sides of the folds and also allow an identified lesion to be focused and clearly delineated.<sup>[7]</sup> In a previous report on use of magnetically maneuverable capsule, which was a modified PillCam COLON capsule in ten human subjects, good, but not complete, gastric visualization was reported.<sup>[11]</sup> The results in one comparative study suggest that lesion detection is similar for magnetically maneuvered capsule and gastroscopy, with mean procedure of CE for stomach examination being 30 min.<sup>[12]</sup> Similar encouraging results have also been obtained with use of magnetic maneuverability in esophagus.<sup>[13]</sup>

Although in the present trial colonoscopic control was used, this is not feasible if CE is to be used as an alternative to colonoscopy. In such a situation, a real-time viewing of the study would be required as also active involvement of trained personnel to ensure adequate visualization of the bowel wall and lesions. With magnetic control, however, the time required to visualize the colon may reduce as the colon CE will no longer remain a passive procedure, but an active one where capsule movement may be controllable with the magnet. The present report merely provides an initial study to test the feasibility of use of magnetic maneuverability for colonic visualization. Hopefully, this technique may also help in evaluation of stomach and other areas of bowel. With more studies and improvement in the technology, the hope of a therapeutic CE may become a reality in times to come.

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