

## The Dilemma of Incomplete Colonoscopy: What Is the Next Best Test?

Colonoscopy remains the gold standard for colorectal cancer screening and surveillance. A complete colonoscopy to the cecum is critical to rule out significant lesions in the right colon. As such, a vital quality metric is the cecal intubation rate.<sup>1</sup> This is particularly important because interval colon cancer is located in the proximal colon more often, highlighting the importance of a complete examination.<sup>2</sup> However, despite endoscopists' best efforts, incomplete colonoscopy still occurs; ranging from 5% to 10%.<sup>3</sup> This often is caused by technical difficulties secondary to older age, female sex, diverticulosis, angulation, prior abdominal surgeries, redundant colon, patient discomfort with conscious sedation,<sup>4</sup> and poor preparation.

The preferred test after an incomplete colonoscopy is not entirely clear. Some endoscopists prefer to repeat the colonoscopy using different techniques such as the use of an upper or pediatric endoscope, double- or single-balloon colonoscopy,<sup>4</sup> or the water method.<sup>5</sup> Other physicians consider barium enema or computerized tomography colography (CTC). According to the 2007 guidelines by the American Gastroenterological Association, the current recommendation after an incomplete colonoscopy is CTC.<sup>6</sup> At our institution, for example, we usually perform same-day CTC after a colonoscopy has been deemed incomplete, avoiding the need for repeat bowel preparation. CTC, however, is not a perfect modality: it is operator-dependent and has a miss rate of 20%.<sup>7</sup> The use of single- and double-balloon colonoscopy is reported to achieve high cecal intubation rates and retains its therapeutic capability.<sup>2</sup> However, none of these modalities is a perfect alternative and when and what to perform after incomplete colonoscopy has not been studied adequately to date.

The colon capsule endoscope (CCE) first was developed in 2006. The first-generation colon capsule (CCE-1) has 2 cameras on both ends, acquiring 4 images per second.<sup>8</sup> The most recent colon capsule (CCE-2) has a wider-angle lens and acquires images at a substantially higher rate (35 frames/s).<sup>8</sup> In contrast to the small-bowel capsule, the CCE has a longer battery life and the battery can hibernate after ingestion until it reaches the colon.<sup>8</sup> Based on a meta-analysis evaluating the accuracy of CCE, the pooled data from 626 patients showed a sensitivity of 73% and a specificity of 89% for any finding. For polyps larger than 6 mm in size or for 3 or more polyps, the sensitivity and specificity were 69% and 86%, respectively.<sup>9</sup> As such, one possible niche for this innovative device may be in patients with incomplete colonoscopy.

In this issue of *Clinical Gastroenterology and Hepatology*, Alarcon-Fernandez et al<sup>10</sup> conducted a prospective study of 34 patients with the CCE-1 after an incomplete colonoscopy. The aim of their study was to assess the effect on medical decision making with the use of this device. The study was an observational one with a retrospective review to see if the results obtained with CCE altered their patients' management. The investigators found that the information obtained from CCE

allowed formulation of a specific medical plan in 20 patients (58.8%). Twelve patients (35.2%) had irrelevant or no lesions, 7 patients (20.5%) required polypectomy or surgery for advanced neoplasia, and 1 patient (3%) was treated for Crohn's disease. Inconclusive CCE examinations resulted from poor preparation of the bowel (n = 12), and excessively slow (n = 1) or rapid (n = 1) capsule transit time. The strengths of the study included the fact that consecutive patients with incomplete colonoscopy were included prospectively. In addition, 2 experienced reviewers were blinded, and there was a third adjudicator.

We applaud the initiative of Alarcon-Fernandez et al to evaluate this novel technique for use after incomplete colonoscopy. We also believe that the colon capsule has great potential, however, we must be careful about adopting this technology prematurely without more data. This study still leaves many unanswered questions with regard to the colon capsule's effectiveness. For example, it is unknown from this study whether the anatomic location missed by conventional colonoscopy actually was reached with the CCE (there was no marking via tattoo or clip). Of greater concern is the fact that there was no attempt to confirm the CCE findings or lack thereof with another imaging technique such as CTC. It is imperative to know if CCE missed any significant lesions. Another concern with the CCE is the fact that the rectum was reached in only 73.5% of patients. Also unsettling is the fact that in those in whom the study was deemed inconclusive (41.2% patients), the main reason was poor visualization hampered by an inadequate bowel preparation. These confounding issues, along with the use of the first-generation CCE, leave us with more questions than answers as to whether or not the device is useful in incomplete colonoscopy.

Undoubtedly, a major challenge associated with colon capsule is bowel cleansing,<sup>8</sup> and this issue must be overcome if the CCE is to find its place in evaluating the colon. For adequate visualization of the mucosa, the colon must be distended fully with fluid to facilitate a clear view as well as propelling the capsule throughout the colon to the rectum. There are different regimens according to published literature, however, a typical bowel regimen for the colon capsule includes the conventional colonoscopy preparation (4 L Golytely; Braintree Laboratories, Braintree, MA) with additional laxatives and prokinetics. This study did not define well the patient tolerance of the extensive bowel cleansing necessary for optimal use of the colon capsule.

Finally, in this environment of cost containment, we must consider expense. Cost effectiveness was not addressed in this study, but it is relevant. The colon capsule is expensive and time-intensive for the gastroenterologist interpreting the images.<sup>11</sup> In that study, 4 of 12 patients required a third intervention. In the present study, the colon capsule reached the rectum in 25 of 34 (73.5%) patients. Nearly half (n = 14) of the subjects had an inconclusive CCE; 6 of 33 patients required a repeat procedure with polypectomy. In 2 of the 33 patients proximal lesions were found on CCE, however, no intervention was pursued. All of these factors suggest that the efficacy compared with the cost of CCE still may be suboptimal.

In conclusion, we commend Alarcon-Fernandez et al for investigating the colon capsule for use in incomplete colonos-

copy. The colon capsule appears to be a safe and feasible diagnostic technique to investigate the colon, however, to gain acceptance, we will need to better understand its overall sensitivity and specificity. Studies thus far suggest that it is limited by moderate accuracy and lack of therapeutic capability. Furthermore, if a polyp is identified, those patients still will require an intervention for polypectomy. Although it is evident from this study that medical decision making was impacted by the addition of a colon capsule in 20 of 34 patients (58.8%), it is not clear that the yield is any better than the current modalities available. Perhaps there is not a one-size-fits-all solution for incomplete colonoscopy and, instead, different modalities may be used depending on the etiology for the initial failure. To answer these questions completely and clarify this dilemma, larger prospective studies are needed to compare CCE with different modalities. Until then, the next best test after incomplete colonoscopy still is undefined.

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#### Conflicts of interest

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