

## Colon capsule endoscopy is feasible to perform after incomplete colonoscopy and guides further workup in clinical practice

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**Background:** Colon capsule endoscopy (CCE) could be an option to examine the colon after incomplete colonoscopy.

**Objective:** To investigate the extent that CCE complements incomplete colonoscopy and guides further workup.

**Design:** Prospective, follow-up study.

**Setting:** Three tertiary-care centers.

**Patients:** Consecutive outpatients after colonoscopy failure; 1-year study period.

**Intervention:** Patients underwent CCE either immediately after colonoscopy or were rescheduled. Further investigations were guided by the results of CCE. Patients were followed as long as 2 years.

**Results:** We studied 75 outpatients; 39 had a screening colonoscopy. One third of the patients underwent CCE immediately after colonoscopy. Overall, CCE reached or went beyond the colon segment at which colonoscopy stopped in 68 patients (91%). CCE technically complemented difficult colonoscopy independently of whether same-day CCE was performed (24 [96%]) or was not performed (44 [88%]). CCE detected additional significant findings in 36% of the same-day CCE cases and in 48% of the rescheduled ones. Two patients in the same-day group and 13 in the rescheduled CCE group underwent further colon examination that revealed additional significant findings in 3 of them. Ten percent of the patients reported mild adverse events (AE). If needed, 63 participants (84%) were willing to repeat CCE. Follow-up has not identified symptomatic missed colon cancers.

**Limitations:** Selected patient population, first-generation colon capsule, old preparation scheme.

**Conclusion:** CCE performed immediately or at a scheduled date after colonoscopy failure is feasible and safe. CCE after incomplete colonoscopy appears to yield significant findings, guide further workup, and has high patient acceptance. (*Gastrointest Endosc* 2014;79:307-16.)

*Abbreviations:* CCE, colon capsule endoscopy; AE, adverse event.

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Cecal intubation rates of higher than 90% and 95% are recommended for routine and screening colonoscopies, respectively.<sup>1</sup> Reasons for colonoscopy failure include patient discomfort, inadequate bowel preparation, presence of acute angulations or fixed loops of the colon, and lumen obstruction. In such cases, there is a need for further investigation to complete the colon examination.<sup>2</sup>

Colon capsule endoscopy (CCE) by using first-generation capsule has been extensively compared with colonoscopy for the detection of colon polyps with a sensitivity and specificity of 69% and 86%, respectively, for significant findings.<sup>3</sup> Recently, the second-generation capsule, which integrates technological innovations with a revised split-dose colon preparation protocol has shown better diagnostic accuracy.<sup>4,5</sup>

In 2012, the European Society of Gastrointestinal Endoscopy<sup>6</sup> recommended CCE as a feasible and safe tool for the visualization of the colon in patients with incomplete colonoscopy without obstruction, based on limited published data.<sup>7-9</sup>

The primary aim of our study was to prospectively investigate the feasibility of CCE after failed colonoscopy. We also evaluated further CCE-based workup and patient acceptance of the examination in clinical practice.

## PATIENTS AND METHODS

### Ethical consideration

Ethical approval for the study was obtained from the institutional review boards of all participating centers. All patients gave informed consent at enrollment. This work was not supported financially or otherwise by external sources.

### Study design

This was a prospective study with follow-up observation of current clinical practice.

### Population

Between June 2009 and May 2010, we invited eligible patients from 3 tertiary endoscopic facilities to participate in the study. We included all outpatients 18 years of age and older who had undergone an incomplete colonoscopy because of excessive looping or acute bowel angulations, discomfort (unbearable pain that precluded continuing colonoscopy under conscious sedation/analgesia), and asymptomatic tumor obstruction at the rectosigmoid junction.

We excluded patients with indications for partial colon examination, incomplete colonoscopy because of inadequate preparation, history of colectomy, colon obstruction proximal to the rectosigmoid junction, suspected or confirmed small-bowel stenosis, use of medications that may alter bowel motility, contraindication to purgative

### Take-home Message

- Colon capsule endoscopy (CCE) can successfully complement incomplete colonoscopy. It reveals significant findings and guides further diagnostic and therapeutic workup safely, with high accuracy and patient acceptance.
- Data suggest that in a subgroup of patients, CCE can be performed safely and successfully, even immediately after incomplete colonoscopy.

preparation or domperidone administration, the presence of severe comorbidities or high risk of surgery if needed, pregnancy, and those who refused to consent.

### Interventions

All colonoscopies were performed by or under the supervision of a senior endoscopist with a standard colonoscope (CF-Q145L or CF-Q160L; Olympus, Tokyo, Japan) after bowel preparation with polyethylene glycol solution. In cases of incomplete colonoscopy, the reason for incomplete examination and the segment of examined colon were recorded. Conscious sedation/analgesia (midazolam/pethidine) was administered on demand.

After incomplete colonoscopy, eligible patients who consented to participate in the study underwent CCE either on the same day or they were rescheduled, depending on the timing of the colonoscopy, facility's workload, and patients' preference.

Patients who underwent same-day CCE received the second-day part of the bowel preparation as described by Schoofs et al<sup>10</sup>: 1 L of polyethylene glycol after incomplete colonoscopy, 2 tablets of domperidone before capsule ingestion, and thereafter 2 oral boosts of sodium phosphate and a 10-mg bisacodyl suppository, as appropriate, whereas patients who underwent CCE on an alternate date followed the full colon preparation protocol.<sup>10</sup>

We used the first-generation PillCam Colon capsule (Given Imaging, Yoqneam, Israel); its characteristics were described in detail previously,<sup>7,10</sup> in accordance with the bowel preparation protocol of Schoofs et al.<sup>10</sup> Patients were discharged either after capsule excretion or after the administration of the second boost of sodium phosphate with specific orders to follow capsule excretion. If the capsule was retained in the bowel, we followed the patients clinically and with radiological imaging, and we managed them accordingly. During the examination, patients were monitored for adverse events (AEs). All patients answered the question "Will you repeat CCE, if needed?" before discharge.

An experienced physician in capsule endoscopy who was aware of the colonoscopy findings reviewed CCE videos at each center by using RAPID software (Given Imaging), at a speed that did not exceed 10 frames per second. Images

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