

Colon Capsule Endoscopy



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KEYWORDS

- Colon capsule endoscopy • Incomplete colonoscopy • Regimen of preparation
- Accuracy • Fields of application

KEY POINTS

- Colon capsule endoscopy (CCE) is a minimally invasive, painless endoscopic tool that allows colonic investigation without requiring intubation, insufflation or sedation.
- CCE is not an alternative to colonoscopy, but a complementary test for average-risk patients unwilling or unable to undergo colonoscopy, and cases of incomplete colonoscopy.
- For such indications, CCE is advantageous because it is minimally invasive and allows direct visualization of the colonic mucosa with good accuracy, without radiation exposure.
- CCE bowel preparation must be exhaustive because fecal remains cannot be removed by CCE. It also needs to promote capsule propulsion through the entire small bowel and then through the colon to the rectum.
- The second generation of CCE is an accurate tool for colonic evaluation.

INTRODUCTION

Colorectal cancer (CRC) is a leading cause of cancer death around the world, being the second most common cause of cancer-related death in developed countries with 500,000 deaths per year worldwide.¹ The procedure of choice for CRC prevention is colonoscopy, which allows the identification and removal of premalignant adenomatous polyps.^{2,3} Although the risk of colonoscopy-related severe complications is small, conventional colonoscopy is perceived as an invasive and potentially painful procedure, which requires conscious or deep sedation and takes place in an unpleasant setting.^{4,5}

Colon capsule endoscopy (CCE) was initially released in 2006 by Given Imaging (Yoqneam, Israel).^{6,7} More recently the technology has been implemented, and a

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second generation of CCE is now available.^{8–10} CCE allows a minimally invasive, painless colonic investigation without requiring intubation, insufflation, or sedation, allowing the pursuit of normal daily activities during the procedure.

According to the European Society of Gastrointestinal Endoscopy (ESGE) guidelines, CCE can be used in average-risk patients, in patients with a previous incomplete colonoscopy, in those unwilling to undergo conventional colonoscopy, or in those for whom colonoscopy is not possible or contraindicated.¹⁰

PILLCAM COLON CAPSULE SYSTEM

The Given Imaging diagnostic system is composed of 3 main subsystems: the ingestible capsule endoscope (second-generation colon capsule), the Data Recorder, and the RAPID workstation. The second-generation CCE (PCC-2) is 11.6 × 31.5 mm in size.^{8,9} It has been endowed with a battery lasting about 10 hours and has 2 cameras, one at each end, with an angle of view of 172° for each camera, allowing a near full visual coverage of the colon. To enhance colon visualization and to save battery energy and video reading, the capsule is equipped with an adaptive frame rate (AFR), which alternates from 35 images per second while in motion to 4 images per second when virtually stationary. At the moment of the ingestion the capsule begins working, using AFR allowing proper visualization of the esophagus, then slows down to 14 images per minute. When small bowel images are detected, the system switches the capsule to the AFR mode. This advanced system for control of capsule image rate is the result of a bidirectional communication between the capsule and the Data Recorder. The new Data Recorder (Data Recorder 3 [DR3]) not only stores the capsule's incoming images but also analyzes them in real time to control the capsule capture rate of images. When DR3 recognizes that the capsule is virtually stationary, it sets the image capture rate to 4 frames per second. When the DR3 recognizes that the capsule is in motion, it sets the image capture rate to 35 frames per second. The DR3 also assists and guides patients and physicians by means of visual and audio signals throughout the procedure activities. It buzzes, vibrates, and displays instructions on its liquid crystal diode screen to alert the patient to continue the preparation protocol. In practice, when the video capsule has detected intestinal villi, the patient is informed and invited to orally ingest the "booster," according to the preparation regimen.¹¹ On completion of the examination, data from the Recorder are downloaded to the Workstation that is provided with dedicated software (RAPID) for video viewing and processing. The new RAPID software has an integrated tool to estimate polyp size. To make the examination interpretations easier, the new RAPID software has flexible spectral intelligent color enhancement to improve image quality and pathologic visualization.

BOWEL PREPARATION

The current ESGE guidelines for CCE preparation recommend 4 L polyethylene glycol (PEG) solution administered in split doses (2 L the day before the examination and 2 L on the day of the examination, before capsule ingestion) combined with oral low-volume sodium phosphate (NaP) boosters to assist capsule propulsion and excretion (Table 1).¹⁰

In contrast to conventional colonoscopy, it is not possible to clean the colon during the CCE procedure. Therefore colonic preparation is crucial, as even a small amount of debris could interfere with colon capsule capability in identifying colonic polyps, and ultimately compromise the outcome of the procedure (Fig. 1). Colonic preparation for CCE is not limited to achieving an adequate cleansing level, but is also aimed at distending the colonic wall, filling the lumen with clean liquids, and promoting capsule

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