What is the effective clinical use of small bowel capsule endoscopy in real life?

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ABSTRACT

Capsule endoscopy (CE) is a noninvasive and easy method for evaluating the gastrointestinal (GI) tract. Since the wireless CE system was first developed, many new technical improvements have been made in order to gain maximum benefit from thisprocedure. However, at this stage, it remains a diagnostic modality, the main indication for its use being obscure GI bleeding. CE is only contraindicated in symptomatic intestinal obstruction. New indications for use and therapeutic options may become possible with the further development of nanotechnologies.

Keywords: *Capsule endoscopy, small bowell, clinical gastroenterology*

INTRODUCTION

Capsule endoscopy (CE) was first presented by Gavriel Iddan in 1995 and was developed by the company Given Imaging Ltd (Yokneam Illit, Israel); the technique was improved in 1999. Western countries have been using CE since 2001(1). This procedure evolved in order to understand the inner space of the gastrointestinal (GI) tract better. Today, many capsule systems are used in routine practice, including the PillCamSB (Given Imaging Ltd), Endocapsule (Olympus, Japan), Korean MiroCam (IntroMedic, Seoul, Korea), the OMOM capsule (Jinshan Science &Technology Co., Ltd, Chongqing, China), and CapsoCam (CapsoVision, Inc., Saratoga, CA, USA). The general technical features of all capsule systems are similar.

Since the development of the wireless CE system many technical changes have been made in order to obtain maximum benefit from this procedure. An external real-time viewer is one of the most important features of CE, which is especially useful in older and intensive care unit patients, who have a high risk of GI dysmotility. This viewer makes it possible to follow the capsule and, if necessary, to push the capsule through the stomach by endoscopy.

With the wireless CE system, it is now possible to evaluate not only the small intestine but also the colon and esophagus. Although colonic CE and esophageal CE cannot replace the conventional endoscopic procedures that were already considered to be the gold standard, they can be used mainly in cases where the conventional endoscopic procedures are contraindicated and in patients who do not want to undergo endoscopic procedures (2, 3).

During the last 5 years, the image quality obtained with all types of capsules has been improving. Fujin on intelligent chromoendoscopy–assisted CE (FICE) software has recently been incorporated into the new RAPID 6.0 video CE workstation (Given Imaging Ltd). FICE technology decomposes images using three specific wavelengths and reconstructs the images with enhanced surface contrast (4). A new software approach to approximate a three-dimensional representation of the digestive tract surface, utilizing current CE technology, has been tested. The authors showed promising results for polypoid structures and angioectasia (5). The rapid development of artificial intelligence in medical sciences has contributed also to gastroenterology, especially imaging in the GI tracts. In order to eliminate the human and operational weaknesses of the GItractus that may occur during the observation of CE and to provide a clearer identification of the lesions, the evaluation of lesion areas by using computer systems based mainly on contrast-enhanced color and geometric features and the interpretation of these lesions with a convolutional neural network is promising for future (6, 7). Magnetically manipulated capsules may also assist in certain cases, and further therapeutic options (e.g., coagulation) and biopsy might become feasible if this technique is developed further (8).

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Although Small bowel capsule endoscopy is easy to perform for experienced endoscopists, several previous reports and guidelines have recommended that 10–25 cases of video CE interpretation be carried out in order to ensure competence in performing this procedure (9, 10).

Indications and clinical use of capsule endoscopy

The indications for the use of CE are expanding in scope. Widely accepted indications for CE are as follows: obscure bleeding, iron-deficiency anemia, inflammatory bowel disease, abdominal pain, polyposis coli, celiac disease, and small-bowel tumors (11). Emergency CE identified bleeding lesions in 67% of patients with severe overt, obscure GI bleeding and seems to be a promising diagnostic tool with impact on clinical management in such patients (12).

It is not possible to use invasive enteroscopy techniques in all patients. If apatient has to undergo an investigation that may put them at risk, it must be for the sake of curative treatment. For example, if the patient has serious cardiac problems, invasive procedures can be risky. CE can diagnose problems (Figure 1), and risk can be minimized through detection of the cause and localization of the lesion. Invasive imaging methods are not appropriate for patients who have recently experienced acute myocardial infarction; in these cases CE may be helpful in diagnosis (Figure 2). The use of CE as first-line investigation, followed by push enteroscopy/double-balloon enteroscopy (DBE) or intraoperative enteroscopy, is potentially both less invasive and more tolerable. Sidhu et al. (13) showed that 44% of patients could not tolerate DBE; however, DBE was only required in 1 of19 patients in whom CE was performed. Therefore, CE is accepted as the first-line, gold standard technique after gastroscopy and colonoscopy (at least twice with ileum intubation during colonoscopy) for the evaluation of obscure GI bleeding (14). CE is also a good complementary method for route selection for DBE (Figure 3), which has the advantage of the applicability of therapeutic interventions during the procedure (15).

Figure 1. CE revealed huge proximal jejunal arterio-venous malformation in a 21-year-old man who had a cardiac malformation (one ventricular. He died after the surgical resection.

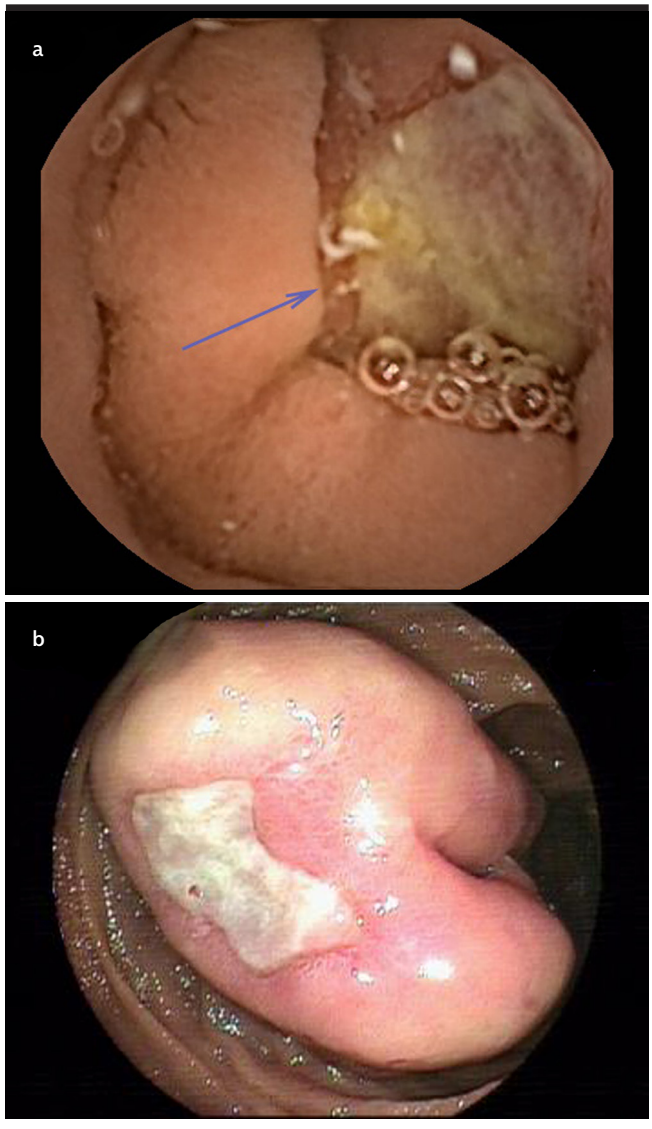

Figure 2. a, b. (a) CE revealed proximal jejunal ulcerated lesion in a 61-year-old man who was followed up in coronary care unit after acute myocardial infarction. (b) Gastrointestinal stromal tumor was detected by upper endoscopy using a colonoscope.

Figure 3. a-c. (a) CE revealed distal ileal ulcer in a 30-year-old man. (b) Meckel diverticula (M-D) were diagnosed by double-balloon enteroscopy through anal way. (c) Visible vessel in the diverticula ulcer.

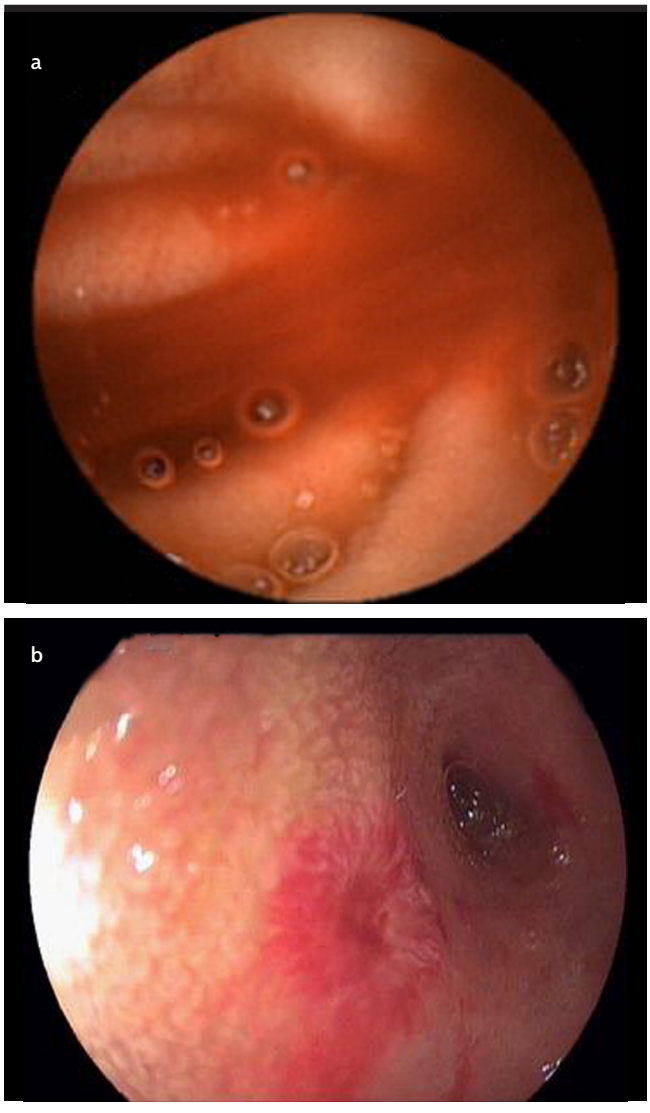

Figure 4. a, b. (a) Active bleeding in bulbus in CE. (b) Vascular ectasia in choledoc.

CE is also an effective method for the detection of lesions that are missed using standard endoscopic procedures. The non–small-bowel lesion rate was 8.3% in our retrospective analysis of 206 CE (Given Imaging Ltd) cases (16). The distribution of lesions was as follows: 40% colon, 26.7% stomach, 26.7% duodenal bulb, and 6.7% choledoc. In all patients, colonoscopy was performed at least once, and gastroscopy was performed between 2and 10times. The colonic lesions were found to be adenocarcinoma in three patients, vascular ectasia in two patients, and diverticula bleeding in one patient. In patients who had choledochoduodenostomy, CE revealed actively bleeding vascular ectasia in the choledoc (Figure 4). Bulbar ulcers and vascular malformations were detected in the others.

However, sometimes it is not possible to use new techniques in real-life situations. In a study, we evaluated 70 patients with obscure GI bleeding between January 2005 and October 2009. Approximately one-third of patients had proximal lesions on CE. Upper GI endoscopy using a colonoscope was performed in patients with proximal lesions and all of these lesions were detected. If small-bowel imaging techniques are not easily accessible, upper GI endoscopy using a colonoscope can be useful for detecting the cause of obscure GI bleeding in some patients (17).

CE can also be used in a different way for evaluating the small bowel. Yamashita et al. (18) reported a different technique for facilitating the diagnosis in obscure GI bleeding. Intraoperative CE combined with a tube (newly developed by the authors) provides surgeons with real-time images indicating the exact site of lesions. The tube also helps surgeons to control the position of the CE and enables suction of intraluminal fluid or inflation of the lumen to allow clearer views during the operation.

Preparation of patient for capsule endoscopy and implementation of the process

Although there is no consensus for the preparation of the patient before CE, we suggest that the patients should take a clear liquid diet the day before the procedure and should be fasting for 8–12 hours before swallowing capsule; In addition, we recommend that the patient should take clear liquid diet during the time when the capsule remains in the patient for 12–14 hours. Intestinal cleansing improves the process quality in CE. Although we do not use an aggressive diet like that used in the colon cleansing, taking into account the patient's medical condition we recommend an aqueous diet and laxatives for CE. Purgative preparation with various agents has been shown to provide better image quality compared with clear liquid diet and overnight fasting. In studies on polyethylene glycol and other prokinetic agents, there is no clear evidence of the superiority of these agents to each other. Since there is a risk of causing aphthous erosions in the mucosa of small bowel, we should avoid agents containing phosphate soda (19).

The capsule is swallowed with water. For patients with swallowing problems or diabetes mellitus who have the risk of gastroparesis, the capsule can be placed with the help of a standard endoscope, or after swallowing the capsule, the patient can be kept under observation, and after 1–2 hours, the capsule can be controlled by the external viewer and if the capsule has not passed the bulb again it can be placed into the small intestine with the help of a gastroscope. Depending on the device used, sensors are dressed to the patient through the belt or vest. Image transmission continues throughout the life of the device battery, then stored in a portable unit, and analyzed after the end of the procedure. The capsule is excreted with feces after 1–7 days of ingestion of capsule (19).

Contraindications and complications of capsule endoscopy

We cannot use CE in some groups of patients. An absolute contraindication to CE is GI tract obstruction and dysmotility. However, retention of the capsule is not a major problem in real life, because this can be treated by surgery if there is a mass or ulcerated lesion, or by balloon enteroscopy (dilatation, retrieve of capsule, etc.). In our experience, the capsule retention rate was 3.2% (11/359), and the capsule was retained in an area with malignant lesions (adenocarcinoma and melanoma in jejunum) in two patients (18%), in an area of ulceration in five patients (45%), and in the esophagus/stomach in fourpatients (37%) because of motility disorders (20). In a study performed by Han et al. (21), 5,348 patients' CE examinations were evaluated and capsule retention rate was 1.4% (77/5,348). In 16 patients, capsule retention was resolved with spontaneous passage; the capsule was removed succesfully by DBE in 14 patients, and 50 patients (2.6%) required surgery.

Whereas retention risk is increased in patients with motility disorders, dysmotility can be under-diagnosed during routine clinical evaluation. In routine practice, we apply contrast computed tomography (CT), magnetic resonance enterography, or CT enterography to evaluate passage in all of our patients before application of CE. However, use of these imaging methods cannot predict retention complications, as indicated in the literature (22,23) .It is important to be aware of the possibility of capsule retention, especially in patients with known or suspected small-bowel ulcers or malignant lesions. Motility disorders should also be carefully evaluated before CE, because the risk of retention is increased in these patients.

CONCLUSION

CE is the gold standard for investigation of obscure GI bleeding. Clinically symptomatic obstruction of the GI tract is the only contraindication toCE. New indications for use and therapeutic options may become possible with the further development of nanotechnologies.

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