

Can we improve the diagnostic yield of small bowel video-capsule endoscopy?

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Received: September 9, 2009 Revised: March 15, 2010

Accepted: March 22, 2010

Published online: May 16, 2010

Abstract

Video-capsule endoscopy has revolutionized the examination of small bowel mucosa. However, this modality is relatively young and its diagnostic yield is low. Herein, we discuss different approaches to improve examination's diagnostic yield. There are strong data supporting some of them while there is speculation about the rest. As capsule endoscopy continues to evolve there is also a strong belief that technology will overcome at least some of the obstacles that hamper capsule endoscopy's diagnostic yield sometime in the near future.

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Key words: Video-capsule endoscopy; Small bowel; diagnostic yield

Peer reviewer: Sherman M Chamberlain, MD, FACP, FACG, AGAF, Associate Professor of Medicine, Section of Gastroenterology, BBR-2538, Medical College of Georgia, Augusta, GA 30912, United States

Triantafyllou K. Can we improve the diagnostic yield of small bowel video-capsule endoscopy? *World J Gastrointest Endosc* 2010; 2(5): 143-146 Available from: URL: <http://www.wjgnet.com/1948-5190/full/v2/i5/143.htm> DOI: <http://dx.doi.org/10.4253/wjge.v2.i5.143>

INTRODUCTION

Small bowel video-capsule endoscopy (VCE) is a powerful, patient friendly and expensive method to examine the small bowel. It has been shown to be superior to any other modality for the examination of small bowel mucosa with a diagnostic yield (DY) around 50%^[1,2]. VCE DY is hampered by the presence of food residue, air bubbles and turbid or green viscous intraluminal fluid. Failure of the capsule to visualize the whole small bowel due to delayed gastric (GTT) or small bowel transit time (SBTT) also results in incomplete examinations. Moreover, the technical characteristics of the available capsule endoscopes are not optimal yet and since wireless capsule endoscopy is an evolving technology it is expected that the forthcoming capsule generations may successfully address some of the above issues. Until then, several methods have been proposed in order to increase examination's DY including use of cathartics and prokinetics, changing body posture, repeating a negative exam etc. with varying results^[2].

The lack of established and validated objective measures and criteria to evaluate VCE DY adds further difficulties for the improvement of examination's DY. Until recently, investigators have used different subjective, unvalidated outcome measures to examine VCE DY and there is no accepted and validated scale to evaluate bowel cleanliness^[2,3]. Moreover, many studies are published in abstract form and randomized controlled, adequately powered studies are still in a minority^[2].

The vast majority of the information provided in this manuscript refers to published data using the Given Imaging Ltd (Israel) capsule. Given Imaging first delivered wireless capsule endoscopy in 2001. More recently, Olympus (Japan) delivered the Endocapsule, Intro-Medic Co, Ltd (Korea) developed the MiRoCam and finally, Chongqing Jinshan Science and Technology Group (China) launched the OMOM capsule for small bowel examination. Actually, few data are available in the literature concerning the Endocapsule (none regarding

our topic) and even less concerning the other two systems (one study regarding VCE completion rate is discussed below).

PURGATIVE BOWEL PREPARATION

The preparation suggested by the capsule manufacturer for VCE (Given Imaging, Yokneam, Israel) is an only clear liquids diet and 8 h fast. However, there is currently strong evidence from a recent meta-analysis that small bowel purgative preparation (polyethylene glycol solution or sodium phosphate) improves examination's DY^[3]. Rokkas *et al*^[3] evaluated data from 12 eligible studies and showed that VCE DY was superior in patients prepared with purgative *vs* those prepared with a clear liquids diet only [OR (95 % CI) = 1.813 (1.251 - 2.628), *P* = 0.002]. Increased VCE DY was the result of better quality of mucosa visualization [OR (95 % CI) = 2.113 (1.252 - 3.566), *P* = 0.005] in patients receiving purgatives. The study did not detect any advantage of purgative bowel preparation regarding VCE completion rate, VCE GTT and VCE SBTT.

While there is evidence of the benefit of bowel preparation for VCE, there is no consensus on the preparation regimen yet. Several investigators favour a half dose of purgative in the evening before the examination^[3], other investigators prefer colonoscopy-like preparation^[3] while some advocate the administration of the preparation during the examination^[4-6]. The meta-analysis of Rokkas *et al*^[3] showed marginal superiority of sodium phosphate over polyethylene glycol regarding the quality of VCE images. However a formal comparison between these two regimens has not been performed yet and a non-randomized prospective study evaluating the quality of small bowel preparation with sodium phosphate or polyethylene glycol did not detect any difference^[7].

Bowel purge for VCE might be associated with adverse events and patient intolerance but this has not been reported yet^[2]. Moreover, the meta-analysis on bowel preparation for VCE has not detected clinically significant adverse events related to bowel preparation^[3].

SIMETHICONE

It has been consistently shown in randomized controlled trials that simethicone improves small bowel mucosa visibility at least in the proximal part of VCE recording by wiping out air bubbles from bowel lumen, either given alone^[8-11] or in conjunction with purgatives^[4,12,13]. None of the trials showed any benefit of simethicone use regarding VCE completion rate.

PROKINETICS

VCE completion rate is about 80%^[1-3]. Retrospective studies have identified factors like inpatient status^[14,15], previous abdominal surgery^[15,16], poor bowel cleansing^[15] and prolonged GTT^[15] to predict incomplete small bowel

VCE examination. There is still controversy whether advanced age^[14,17,18] and diabetes mellitus^[15,19,20] predict incomplete VCE studies.

In order to improve VCE completion rate, the use of prokinetics has been studied. The initial studies of oral erythromycin^[21] and oral metoclopramide^[22] showed marked reduction of the GTT but later studies showed no benefit of using these prokinetics either alone^[23-26] or in conjunction with purgatives^[13] regarding improving VCE completion rate.

Recent prospective randomized trials with mosapride^[27], lubiprostone^[28] and bisacodyl^[29] also failed to show any benefit regarding the completion rate of the examination and new powerful prokinetics are not on the horizon after the withdrawal of tegaserod.

OTHER INTERVENTIONS

Another approach to improve VCE completion rate could be the follow-up of the capsule in the stomach by using the real-time viewer (Given Imaging, Yokneam, Israel) which offers real-time inspection of the alimentary lumen peri-procedurally. In case of delayed GTT, intervention with endoscopic advancement of the capsule in the duodenum could be applied^[5,30]. Moreover, the use of the real time viewer to optimize the timing for the administration of bowel preparation in order to improve the quality of bowel preparation is promising^[5] but it has not been studied extensively yet.

Investigators also studied placing the patient in the right lateral position after swallowing the capsule in order to decrease the GTT but this approach has reached conflicting results; one study in favor and one against^[31,32].

In an elegant prospective, randomized, single-blinded controlled trial, 93 consecutive patients were randomized to either use chewing-gum or not in order to determine whether chewing-gum increases the ability of VCE to reach the cecum^[33]. Complete VCE examination rate was higher in the chewing-gum group compared with controls (83.0% *vs* 71.7% respectively, *P* = 0.19) and both GTT and SBTT were significantly shorter in the chewing-gum *vs* control group^[33]. These data suggest a potential positive role of sham feeding to accelerate the passage of the capsule to the cecum.

One prospective randomized controlled study from China^[34] examined the hypothesis that reduction of the image capture rate in the stomach saves battery's life and thus allows the operating capsule to reach the cecum. Fifty patients who underwent the OMOM [Chongqing Jinshan Science & Technology (Group) Co., Ltd, Chongqing, China] small bowel capsule-endoscopy were randomized into 2 groups: modified image capture rate (initially set at 0.5 frames per second and then modified to 2 frames per second once the capsule passed the pylorus) group and the control group (image capture rate set at 2 frames per second during the entire recording). VCE completion rate was 100% in the modified image capture rate *vs* 72% in the control group (*P* = 0.014)

showing the impact of technological improvement for the completion of the examination^[34].

When there is strong evidence for the presence of small bowel mucosa lesions despite a negative VCE examination, there are several approaches for further evaluation including enteroscopy, radiology or a second capsule endoscopy. Patients with occult gastrointestinal bleeding with nondiagnostic VCE underwent a “second-look VCE” if they manifested a new bleeding episode or a drop in hemoglobin ≥ 2 g/dL^[35]. “Second-look VCE” was diagnostic in those patients whose presentation changed from occult to overt or those whose hemoglobin dropped ≥ 4 g/dL showing that a certain proportion of patients with a negative VCE may benefit from the repetition of the examination^[35]. However, it has not been tested yet if this approach is cost-effective.

CONCLUSION

Capsule endoscopy is a useful modality to evaluate small bowel mucosa lesions. However, examination's DY is low. Until the development of new generation capsules equipped with technology that will overcome obstacles such as poor mucosa visibility and limited life span of the battery, purgative bowel preparation and simethicone use are essential to improve the DY of the examination. Dual-camera small bowel capsule endoscopy might also increase DY but it has not been formally tested^[36]. Prokinetic use and changing body posture are useless while sham feeding e.g. chewing-gum, might be helpful in order to increase the completion rate of VCE.

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S- Editor Zhang HN L- Editor Roemmele A E- Editor Liu N