

# Video capsule endoscopy: procedure, indications and diagnostic yield

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## ABSTRACT

Video capsule endoscopy (VCE) is a new noninvasive imaging technique for the complete small bowel. It provides good to excellent visualisation of the mucosa of the small bowel and has a high diagnostic yield in selected patients with gastrointestinal blood loss of suspected small bowel origin and in patients with Crohn's disease. In comparison with small bowel X-ray and push enteroscopy, diagnostic yield appears to be superior. Although VCE is becoming increasingly popular, good studies on its clinical implications and application are only just emerging. In this paper we review the possibilities and limitations of clinical application of VCE.

## INTRODUCTION

In the late 19<sup>th</sup> century, gastroenterology was among the first recognised medical specialities. Gastroenterologists had a great need for visualisation of the gastrointestinal tract but for a long time they were only equipped with rigid endoscopy and bowel X-ray. The introduction of flexible endoscopy in the early 1970s largely changed medical practice, with one exception. The small bowel distal of Treitz's ligament to the terminal ileum remained a blind spot for endoscopy. Several important diseases such as Crohn's disease, angiodysplasias and tumours are frequently found in this part of the small bowel and often lead to clinical symptoms, such as bleeding or obstruction. Until recently the small bowel was examined by enteroclysis, computed tomography, push enteroscopy or by peroperative enteroscopy. VCE is a new diagnostic tool that can provide images of the entire small bowel in a noninvasive way.

Several papers and numerous abstracts have been published on the use of VCE. In this review the technical aspects of the procedure, indications and diagnostic yield will be discussed.

## PROCEDURE OF VIDEO CAPSULE ENDOSCOPY

The video capsule is a small device with a diameter of 11 mm and a length of 26 mm which can be swallowed. It contains six light-emitting diodes, a lens, a colour camera chip and two batteries. The colour camera chip can operate at very low levels of illumination. In the rear dome of the capsule a transmitter and an antenna are located. The capsule obtains two images per second and transmits the data to eight aerials attached to the abdominal wall of the patient. These aerials are connected to a recording device. The recorder and a battery are worn in a belt around the waist.<sup>1</sup> After an overnight fast, the patient swallows the capsule, which is propelled by intestinal peristalsis (*figure 1*). Four hours after ingestion of the capsule, a light meal and a drink are allowed. During the procedure patients can move around freely. After seven to eight hours an indicator on the recorder shows if the capsule has run out of power. The capsule is finally passed with the stools and is not reusable. Eight hours after capsule intake, the recorder is connected into the workstation to download the images which are converted into a movie. Data are reviewed by looking at an operator-determined number of images per second with dedicated software. The best results are obtained in a dark environment because this enhances

image contrast. Images with abnormalities can be selected and stored for review in a separate file. For an experienced investigator it takes about 45 minutes to interpret all the images. In our experience the learning curve comprises about ten investigations. Interobserver agreement appears to be high.<sup>2</sup> Several software applications are available such as automated red detection, which enables fast selection of images with blood, and capsule localisation, which facilitates anatomic localisation of abnormalities. These applications need further development but might enhance diagnostic efficacy in the future.

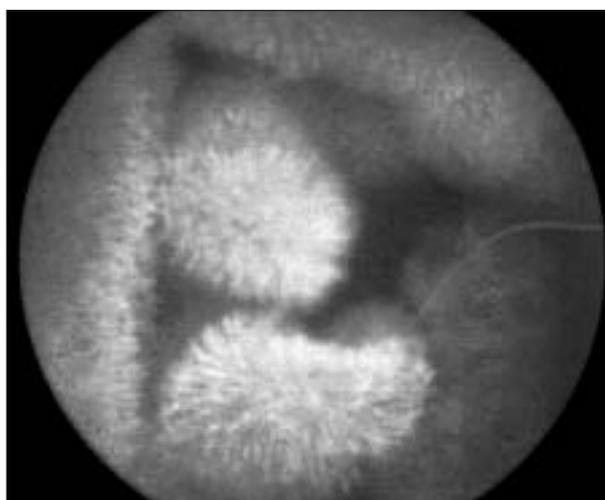
## INDICATIONS AND CONTRAINDICATIONS

The most important indication for VCE is obscure gastrointestinal bleeding of suspected small intestinal origin. Patients with iron-deficiency anaemia, melaena or haematochezia are good candidates for VCE when gastroduodenoscopy and colonoscopy are normal (*figure 2*).<sup>3-9</sup> Another important indication is suspected small bowel Crohn's disease (*figure 3*).<sup>10-13</sup> The indications for VCE will probably expand in the near future based on ongoing research in patients with other diseases, such as celiac disease, small bowel tumours, Rendu-Osler-Weber disease, polyposis syndromes and small bowel transplantation.

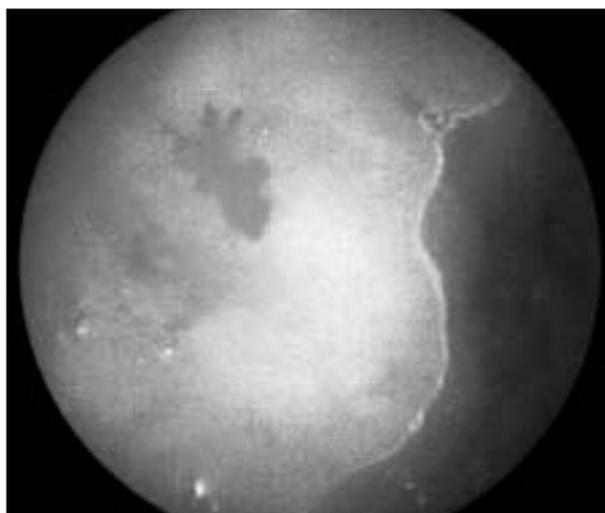
The main contraindication is the presence or suspicion of small bowel stenosis due to previous gastrointestinal surgery, a tumour or fibrotic strictures. This may lead to capsule retention and obstruction. In patients who have undergone gastric surgery or with gastroparesis, the capsule can be placed endoscopically in the small intestine at the start of the investigation. Other contraindications for VCE are difficulty with swallowing, pregnancy or the presence of implanted electronic medical devices such as pacemakers.

## PASSAGE, RETENTION AND OBSTRUCTION

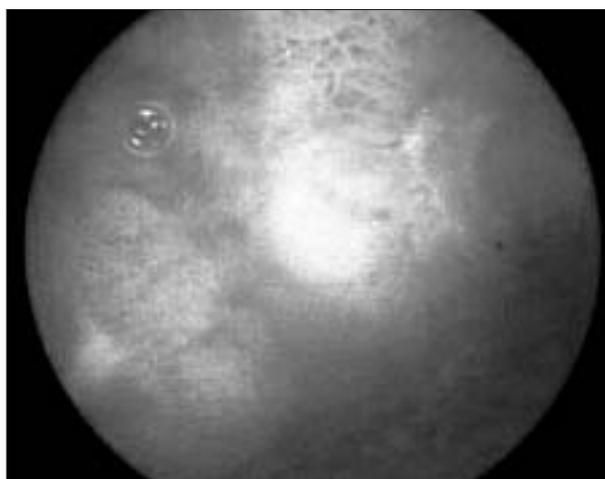
Stomach passage takes an average of 34 minutes and the small intestine is passed in about four hours.<sup>14</sup> This means that the average passage to the caecum takes 4.5 hours. Visualisation of the complete length of the small bowel up to the caecum is achieved in 80% of the patients. In the remaining 20%, batteries are worn out before the capsule reaches the caecal valve. In the newer-generation capsule, improved batteries with a life-span of eight instead of six hours have been introduced. This is likely to increase the proportion of patients with complete small bowel visualisation. In 0 to 5% of patients, retention of the capsule proximal to a previously undiagnosed obstruction is reported.<sup>14-16</sup> This generally does not produce any symptoms because real



**Figure 1**  
*Duodenal mucosa with characteristic villi*



**Figure 2**  
*Small intestinal angiodysplasia*



**Figure 3**  
*Ileal ulceration in a patient with Crohn's disease*

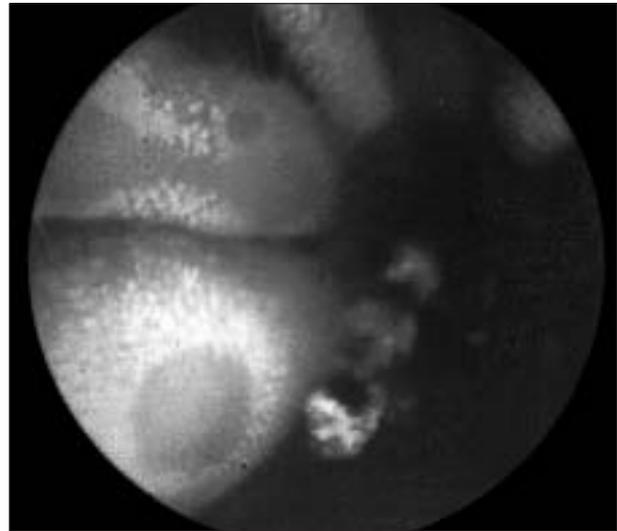
impaction of the capsule seldom occurs.<sup>15,16</sup> The capsule can remain in the intestines for at least three months. If the capsule is retained in the stomach or colon, it can be removed endoscopically. Otherwise, surgery is necessary to remove the capsule. During surgery, serious abnormalities are usually found at the level of obstruction, such as fibrotic or inflammatory stenosis or tumour.

## DIAGNOSTIC YIELD

Most studies on diagnostic yield of VCE comprise patients with obscure occult or overt gastrointestinal bleeding (OGIB). Combined data from several studies show that the diagnostic yield in this patient population varies between 60 and 92%.<sup>3-9,14,16</sup> This is very high when taking into account that all patients were extensively examined by other means before capsule endoscopy was applied. Unfortunately, however, most studies do not classify lesions as possibly or definitely responsible for haemorrhage. This might cause considerable bias in assessing diagnostic yield. In our experience, the most frequent finding in OGIB is small bowel angiodysplasia.<sup>14</sup> In patients with Crohn's disease, with or without suspected small bowel involvement, the diagnostic yield varies between 60 and 70%.<sup>10-13,14</sup> Capsule endoscopy frequently reveals previously undiagnosed ulcers or focal villous denudation (*figure 4*).<sup>17</sup> If in the near future capsule endoscopy were to gain acceptance as a first-line diagnostic tool, diagnostic yield would be likely to decrease in less strictly selected cases, such as patients with intestinal bleeding more than ten days before video capsule endoscopy<sup>16</sup> or patients with abdominal pain and no other abnormalities.

## COMPARISON WITH OTHER TECHNIQUES

Several studies have compared diagnostic yield of capsule endoscopy with small bowel X-ray examination.<sup>8,11</sup> Enteroclysis in patients with OGIB has a diagnostic yield of 20% and in Crohn's disease of 37%, while capsule endoscopy has a yield of 85 and 70% respectively. This is not surprising since enteroclysis will not easily detect flat or mucosal abnormalities. Other investigators have compared the yield of VCE and push enteroscopy.<sup>4,7,18</sup> Push enteroscopy is a technique by which a dedicated long endoscope is introduced as far as possible in the small intestine in a sedated patient. Push enteroscopy appears to be inferior to VCE with regard to diagnostic yield (about 35% vs about 65%) since the capsule examines the whole small bowel and push enteroscopy only the upper part. A serious advantage of push enteroscopy is that when abnormalities are found, biopsies can be taken and thera-



**Figure 4**  
*Focal villous denudation*

peutic interventions such as plasma argon coagulation can be carried out. Diagnostic yield of video capsule endoscopy is comparable with intraoperative enteroscopy, which offers visualisation of the complete small intestine. This is, however, invasive and is likely to carry a higher risk of complications.<sup>19</sup> Recently, a new double-balloon endoscope was introduced enabling visualisation of the entire small bowel. The technique is based on sequential inflation and deflation of two balloons, one attached to the tip of the endoscope, the other to an overtube, allowing stepwise progression of the tip of the endoscope through the small bowel. With this endoscope biopsies can be taken and therapeutic interventions can be performed.<sup>20,21</sup> Future research will certainly focus on the comparison between VCE and this technique.

## CLINICAL IMPLICATIONS OF VCE

To date, very few published data are available on the long-term effects of video capsule endoscopy results on patient outcome. Data from several preliminary reports suggest that VCE changes clinical decisions and treatment in 25 to 87% of patients.<sup>16,22-24</sup> The clinical implications vary widely, due to different patient populations, different criteria for measuring effects, short follow-up periods and lack of a gold standard for diagnosis and treatment. However, clinical implications are still impressive since before the advent of VCE all treatment options were usually exhausted for these patients. Controlled long-term follow-up studies for distinct indications are needed to establish the real clinical value of VCE. It also appears that VCE performs optimally in strictly selected patient populations. Application in a general population will grossly decrease its yield.

## CONCLUSION

VCE is a promising diagnostic tool for noninvasive investigation of the small bowel. The most important current indications are OGIB with or without anaemia with negative gastroscopy and colonoscopy, and suspicion of small bowel Crohn's disease. The diagnostic yield of VCE appears to be high and is probably superior to enteroclysis and push enteroscopy. However, the yield may decrease when it is performed as a first-line diagnostic tool. The major disadvantage of the procedure is the inability to take biopsies or perform coagulation of bleeding spots. Long-term follow-up studies are needed to evaluate the impact of VCE on disease management and on patient health. Only then can its position in medical management of OGIB and Crohn's disease be established.

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