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Chapter 8

Double-balloon endoscopy as the primary method for small-bowel video capsule endoscope retrieval

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Summary

Background

Capsule retention in the small bowel is a known complication of small-bowel video capsule endoscopy. Surgery is the most frequently used method of capsule retrieval.

We aimed to determine the incidence and causes of capsule retention and to describe double-balloon endoscopy (DBE) as the primary technique used for capsule retrieval.

Methods

We performed a retrospective analysis of 904 small-bowel video capsule examinations performed in our centre and evaluated the outcome of DBE as the first method used to retrieve entrapped video capsules.

Results

Capsule retention occurred in eight patients (incidence: 0.88%; 95% CI, 0.41%–1.80%), and caused acute small-bowel obstruction in six patients. All retained capsules were successfully removed during DBE. Five patients underwent elective surgery to treat the underlying cause of capsule retention. One patient required emergency surgery because of multiple small-bowel perforations

Conclusions

In our series, the incidence of capsule retention is low. DBE is a reliable method to remove retained capsules and might prevent unnecessary surgery. If surgery is required, pre-operative capsule retrieval allows for pre-operative diagnosis, adequate staging in case of malignancy and optimal surgical planning.

Introduction

Video capsule endoscopy (VCE) is a widely used technique to investigate the small bowel.¹ Capsule retention in the small bowel is a known complication of VCE. The reported incidence of capsule retention ranges from 1.4% to 13%.²⁻⁸ Several conditions predisposing patients to capsule retention have been identified, of which Crohn's disease, non-steroidal anti-inflammatory drug (NSAID) enteropathy, and small-bowel tumours are the most prevalent. Retained capsules can be removed surgically or endoscopically by using double-balloon endoscopy (DBE). The latter method has only been described in case reports.⁹⁻¹²

The purpose of this study was to determine the incidence and causes of capsule retention in a tertiary referral centre for small-bowel disease. The secondary aim was to describe DBE as the primary technique used for capsule retrieval.

Patients and methods

Patients

A retrospective review of all patients undergoing VCE from December 2003 to September 2008 at VU University Medical Centre, Amsterdam, The Netherlands, was performed. Our centre is a tertiary referral clinic for small-bowel disease. A total of 904 VCE examinations were performed during the study period. Of these, 182 (20.1%) examinations were performed in patients who underwent consultation in the Department of Gastroenterology and Hepatology before VCE was carried out. The remaining 722 (79.9%) VCE examinations were performed in patients referred from other hospitals. VCE was only performed after medical records were reviewed by one of two gastroenterologists experienced in VCE to assess possible contraindications for VCE, such as symptoms suggestive of small-bowel obstruction, known small-bowel strictures, pregnancy, and dysphagia. If symptoms of small-bowel obstruction were present, radiological small-bowel imaging was recommended. All patients or their legal representatives gave informed consent before the procedure. **Table 8.1** shows the indications for VCE.

Video capsule endoscopy protocol

The Pill Cam SB capsule endoscope (Given imaging, Yoqneam, Israel) was used for 879 (97.1%) of the VCE examinations. For 26 (2.9%) VCE examinations the Mirocam (Intromedic, Seoul, Korea) was used. Patient preparation consisted of 2 litres of polyethylene glycol bowel preparation (Klean prep; Norgine, Amsterdam, The Netherlands) at midday 1 day before the examination and nothing by mouth after midnight before the examination. Patients were allowed liquids 4 hours after ingestion of the capsule and were allowed solid food 8 hours after ingestion of the capsule.

At the end of the examination day, the patients returned the data recorder and were asked to contact our department in case of symptoms suggestive of small-bowel obstruction or if the capsule had not passed with the stool within 14 days. If during the

Table 8.1: Indications for video capsule endoscopy for all 904 patients.

Indication	Patients
Iron-deficiency anaemia	445 (49.2)
Midgastrointestinal bleeding	213 (23.6)
Suspected refractory coeliac disease	78 (8.6)
Crohn's disease	
Suspected	51 (5.6)
Established	13 (1.4)
Abdominal pain	33 (3.7)
(Familial) polyposis	20 (2.2)
Suspected malignancy	20 (2.2)
Other	31 (3.4)

Note: Numbers indicate number of patients, with percentages between parentheses.

diagnostic reading passage of the capsule to the colon was not observed, or if findings suggestive of stenosis were encountered, the patient was contacted to ask if the capsule was excreted with the stool.

Capsule retention was defined according to the consensus statement of the International Conference on Capsule Endoscopy as having a capsule endoscope remain in the digestive tract for a minimum of 2 weeks or as the capsule remaining in the bowel lumen unless directed medical, endoscopic, or surgical intervention was instituted.¹³ Additionally we defined capsule associated small-bowel obstruction as an acute small-bowel obstruction, occurring within 24 hours after ingestion of the capsule.

Abdominal radiographs to investigate possible capsule retention or capsule-related small-bowel obstruction were obtained in case of signs of small-bowel obstruction or in the absence of confirmation of capsule excretion within 2 weeks after the investigation.

Capsule retrieval was deemed indicated in case of confirmed capsule retention > 2 weeks, or in case of small-bowel obstruction with radiological identification of the capsule. For patients referred from our own department, antegrade DBE was the first procedure of choice to retrieve trapped or retained capsules. If patients were referred from another hospital, the referring physician was contacted and DBE was advised and offered. Final decision on the method of capsule retrieval was with the referring physician.

DBE

After informed consent had been obtained, antegrade DBE to retrieve capsules was performed without small-bowel preparation, except nothing by mouth for 12 hours. No retrograde DBE was performed. DBE's were performed with the Fujinon therapeutic double-balloon endoscope (EN-450T5; Fujinon, Saitama, Japan), with an outer diameter of 9.4 mm and a working channel diameter of 2.8 mm. All patients received conscious

sedation with midazolam and fentanyl. Fluoroscopy was used in all procedures. Capsules were grasped by using either a 35-mm opening loop diameter polypectomy snare (MediGlobe GmbH, Achenmühle, Germany) or a 40-mm opening loop diameter net (Roth net; US Endoscopy, Mentor OH, United States) and were retrieved by withdrawal of the endoscope. If other procedures (e.g. obtaining biopsy-specimens, tattoo-placement) had to be performed, this was done before capsule retrieval.

Statistical analysis

The capsule retention rate in patients referred by our department or by other hospitals was compared using the two-sided Pearson χ^2 test.

Results

Incidence and causes of capsule retention

Eight patients (4 men, 4 women, mean age 55 years) had radiological evidence of capsule retention. The overall rate of capsule retention was 0.88% (95% CI, 0.41%–1.80%). Six (75%) of these patients had signs of small-bowel obstruction after VCE. **Table 8.2** shows the details of clinical findings, VCE findings and management of capsule retention. The endoscopic management of capsule retrieval in one of these patients (patient B) was previously published as a case report.⁹

In four patients with capsule retention, radiological imaging of the small-bowel was performed before the VCE-examination but did not show signs of small-bowel obstruction. In one (12.5%) of the eight patients, a patency capsule had passed without any signs of obstruction, before VCE was performed. There was no statistical significant difference in capsule retention rate in patients referred by our department or by other hospitals (3 of 182 *vs* 5 of 722, $p = 0.205$).

In three (37.5%) of eight patients capsule retention was caused by lymphoma (diffuse large B-cell lymphoma, $n = 2$; enteropathy-associated T-cell lymphoma, $n = 1$). In two (25%) of eight patients the cause for capsule retention was small-bowel adenocarcinoma. In two (25%) of eight patients capsule retention was caused by postsurgical small-bowel changes (blind loop, $n = 1$; ulcerative anastomosis, $n = 1$). One patient had capsule retention caused by a Crohn's disease stricture (**figure 8.1**).

Management of capsule retention

All patients with capsule retention underwent antegrade DBE for capsule retrieval (**figures 8.2 and 8.3**). All patients with symptomatic capsule retention underwent DBE within 24 hours after the first symptoms of small-bowel obstruction. In the two asymptomatic patients, DBE was performed 2 weeks (patient G) and 9 months (patient B) after VCE. Fluoroscopy was used in all cases. The mean estimated distance between the pylorus and the retained capsule was 70 (range 35–150) centimetres. Endoscopic

Table 8.2: Clinical details and outcomes of the eight patients with video capsule retention

Case	Sex/Age (y)	Medical history	Pre-VCE small-bowel imaging	VCE indication	VCE findings
A	F/66	Gastric ulcer; diabetes	SBFT: irregular jejunal mucosa; no stenosis	Anaemia; weight loss	Irregular jejunal stenosis
B	M/60	RCD II; EATL resection (end to side anastomosis jejunum)	CT: no residual lymphoma	Follow-up RCD II	No ulcerative jejunitis
C	F/42	Crohn's disease; ileocaecal resection	SBFT: skip-lesions; no stenosis. Normal passage of patency-capsule	Suspected active SB Crohn's disease	Multiple jejunal and ileal ulcers. Jejunal stenosis
D	F/57	Suspected RCD II	MR enterography: no clear abnormalities.	Suspected RCD II	Multiple jejunal ulcers. Stenotic jejunal segment
E	M/84	—	—	MGIB	Fresh blood, irregular jejunal tumour
F	M/10	Small-bowel atresia, multiple segmental resections, short bowel syndrome	Small-bowel ultrasound: no fluid filled loops	MGIB	Stenosis, possibly at anastomosis No cause for MGIB
G	F/83	—	—	Anaemia	Probable stenosis midjejunal
H	M/36	Multiple sclerosis, coeliac disease	—	Suspected RCD II	Congestive small-bowel mucosa, irregular stenosis

Note: F = female; M = male; VCE = video capsule endoscopy; DBE = double-balloon endoscopy; SBFT = small-bowel follow through;

capsule retrieval was successful in all patients (*figure 8.4*). Capsules were retrieved with a polypectomy snare in six patients and with a retrieval net in two patients. Mean procedure time was 55 (range 30–75) minutes. Six patients underwent elective surgery to treat the cause of capsule retention. In all five patients with endoscopic findings suggesting malignancy, an endoscopic tattoo was placed and biopsy specimens were obtained during DBE. All but one of the patients with small-bowel malignancy underwent elective resection by specialized gastrointestinal surgeons after appropriate staging had been performed. One patient developed multiple small-bowel perforations three days after DBE. Three segments with enteropathy-associated T-cell lymphoma and perforation were resected during emergency surgery. In this patient, the capsule was removed from the proximal jejunum. One perforation occurred in this region, whereas two perforations occurred in the distal and terminal ileum.

One patient with Crohn's disease underwent balloon dilation of the two inflammatory stenotic jejunal lesions during the same endoscopic procedure in which the capsule was removed and prednisone was started to induce remission (*figure 8.4*). Because of relapsing

Symptoms after VCE	DBE findings	DBE intervention	Final diagnosis	Outcome
Vomiting, abdominal pain	Capsule trapped in stenosis; circular, irregular tumour.	Capsule retrieval (snare) Biopsies Tattoo	Non-Hodgkin lymphoma	Segmental resection after staging. Chemotherapy
—	Capsule in blind loop end to side anastomosis	Capsule retrieval (snare)	No residual lymphoma	Capsule removed to facilitate MR enteroclysis
Vomiting, abdominal pain	Capsule trapped in jejunal stenosis.	Capsule retrieval (snare) Endoscopic balloon dilation	Jejunal Crohn's disease	Clinical remission after prednisone. Elective segmental resection of 2 stenotic jejunal segments 8 months after capsule retention.
Vomiting, abdominal pain	Capsule trapped in irregular stenosis	Capsule retrieval (snare) Biopsies Tattoo	EATL	3 days after DBE multiple small-bowel perforations. 3 segmental resections, all locations with EATL.
Abdominal pain	Capsule trapped in stenosis	Capsule retrieval (net) Biopsies Tattoo	Adenocarcinoma	Surgical resection after staging
Abdominal pain	Capsule trapped in narrowed anastomosis	Capsule retrieval (net)	Narrowed surgical anastomosis	No surgery performed
—	Midjejunal circular stenosis	Capsule retrieval (snare) Biopsies Tattoo	Adenocarcinoma	Elective surgical resection after staging
Abdominal pain	Stenotic midjejunal tumour	Capsule retrieval (snare) Biopsies Tattoo	Non-Hodgkin lymphoma	Elective surgical resection. Chemotherapy

RCD II = refractory coeliac disease type II; EATL = enteropathy associated T-cell lymphoma; CT = computed tomography; MR = magnetic resonance; MGIB = midgastrointestinal bleeding

signs of small-bowel stenosis, without signs of disease activity, both stenotic segments were resected 8 months after DBE.

The two patients with capsule retention as a result of surgical altered small-bowel anatomy did not require surgery.

Discussion

Our study shows that DBE is a reliable and safe method to remove retained video endoscopy capsules. The incidence of capsule retention was 0.88% (95% CI, 0.41%–1.80%) in our series. Two of the patients with capsule retention were asymptomatic, whereas six patients showed signs of small-bowel obstruction caused by capsule retention.

No patient needed emergency surgery for capsule removal. Two patients did not need surgical therapy for the cause of VCE retention. One of these patients was a 10-year old child, which shows endoscopic capsule retrieval is also feasible in young children. In one patient nonsurgical therapy was commenced to treat the cause of video capsule

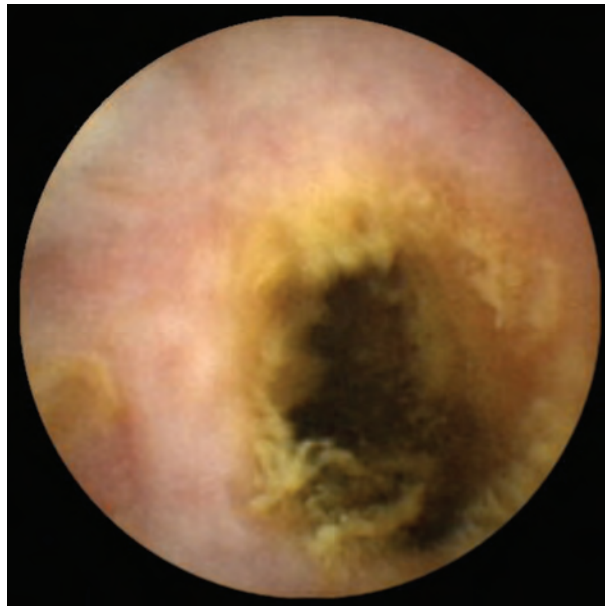


Figure 8.1: Forty-two-year-old woman with Crohn's disease (patient C) and symptomatic capsule retention. VCE image shows an eccentric irregular stenosis that was not passed by the capsule.

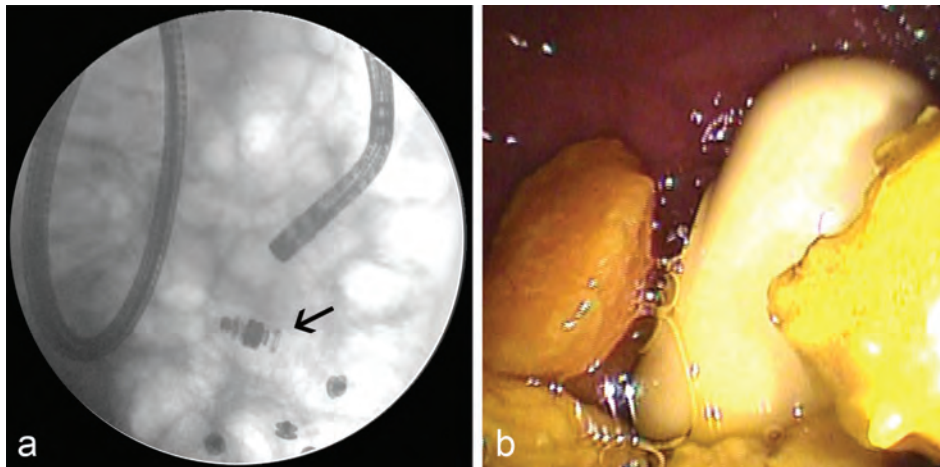


Figure 8.2: Sixty-year-old man (patient B) with asymptomatic capsule retention in a blind postsurgical small-bowel loop. (a) Fluoroscopy image during DBE shows the distal end of the endoscope approaching the entrapped capsule (arrow). (b) DBE image shows the light yellow capsule and adjacent dark yellow food residue.

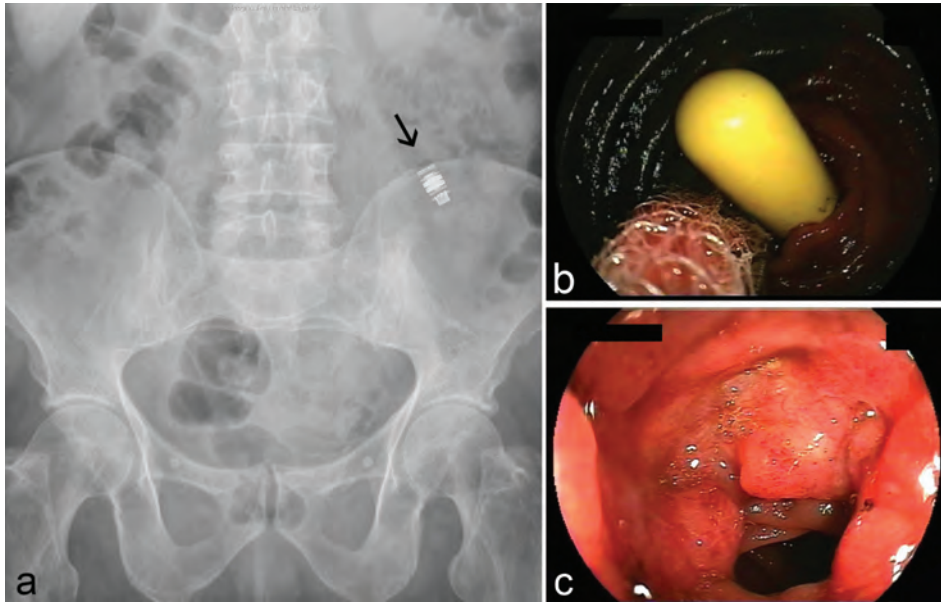


Figure 8.3: Eighty-four-year-old man (patient E) with midgastrointestinal bleeding and symptomatic capsule retention. (a) Plain abdominal radiograph shows the capsule left lower quadrant of the abdomen (arrow). (b) DBE image shows the entrapped video capsule. (c) DBE image after capsule retrieval shows the irregular stenosis caused by jejunal adenocarcinoma.



Figure 8.4: Fifty-seven-year-old woman with refractory coeliac disease (patient D) and symptomatic capsule retention. (a) DBE image shows the front-end of the capsule pointing toward the endoscope. (b) DBE image showing the capsule being retrieved using a snare. (c) DBE image after capsule retrieval shows the irregular ulcerative stenosis that caused the capsule entrapment. Histopathology examination of biopsy specimens showed the lesion to be enteropathy associated T-cell lymphoma.

retention. However, surgery had to be performed within the year after capsule retrieval. Five patients, all with small-bowel malignancy, required surgical intervention within two weeks of DBE, to treat the cause of the capsule retention.

In one of these patients, emergency surgery was performed because of multiple small-bowel perforations 3 days after DBE. All perforations occurred in small-bowel segments

with extensive localizations of lymphoma. Although spontaneous perforation of small-bowel lymphoma have been described earlier and two perforations occurred approximately 4 meters distally from the site of capsule retention, three days after DBE, it cannot be excluded that the perforations were caused by either the VCE or DBE examination.

Although all five patients with capsule retention caused by small-bowel malignancy required surgery, endoscopic capsule retrieval facilitated adequate staging procedures to be performed before surgical resection. Additionally, biopsy specimens obtained during retrieval-DBE resulted in a definitive diagnosis of malignancy before surgery was performed. The endoscopic tattoos placed during retrieval allowed precise localization of the malignancies during surgery. In the patient with capsule retention caused by active Crohn's stenosis, endoscopic balloon dilation and medical induction therapy resulted in mucosal healing before the fibrostenotic segments were resected.

The incidence of capsule retention in our series is lower than reported in most other studies.²⁻⁸ A possible explanation for this low overall retention rate could be that in our series only 64 VCE examinations were performed in patients with Crohn's disease. This is likely the result of our restricted use of VCE for patients with Crohn's disease, because of the known increased risk of retention. Despite this, capsule retention occurred in one patient with Crohn's disease, in spite of previous normal passage of a patency capsule.

Although coeliac disease is not associated with an increased risk of capsule retention, three cases of capsule retention occurred in patients with coeliac disease. However, we usually perform VCE only in patients with suspected refractory coeliac disease, which is associated with the development of small-bowel malignancy.¹⁴ In fact, two patients with coeliac disease in whom capsule retention occurred had a small-intestinal tumour and one had undergone previous small-bowel surgery, both of which are known risks for capsule retention.

We did not encounter any case of NSAID-enteropathy in our study, whereas in one previous study of capsule retention this was the cause of capsule retention in almost 80% of the patients.² In our experience, NSAID-enteropathy related small-bowel stenosis is rare in a Northern-European population.

Six of eight patients with capsule retention had signs of acute small-bowel obstruction. Acute bowel obstruction as the result of a retained capsule has only been described in case reports.¹⁵⁻¹⁷ In the study of Li and co-workers, none of the 14 patients with capsule retention were symptomatic.² Possibly, capsules are more likely to become impacted in malignant strictures than in short, web like strictures, as seen in NSAID-enteropathy.

Although all six patients with symptomatic capsule retention eventually required a surgical intervention, this could be performed in an elective setting in five. In our opinion, emergency DBE to remove retained capsules has several advantages over emergency surgery: (1) Endoscopic capsule retrieval can prevent surgical interventions in cases of small-bowel stenosis that can be managed nonsurgically, e.g., inflammatory strictures in patients with Crohn's disease or obstructive small-bowel polyposis.¹⁸ (2) If surgery is necessary, DBE allows histological sampling to establish the cause of retention before surgery is being performed, allowing optimal planning, patient preparation, preoperative

staging, and perioperative decision making.¹⁹ (3) In patients with a malignant cause of capsule retention, endoscopic capsule retrieval allows correction of malnutrition prior to surgery. Malnutrition in patients with gastrointestinal cancer is associated with increased morbidity and mortality, reduced efficacy of treatment, and increased length of hospital stay.^{20, 21} (4) Analogous with colon cancer, endoscopic tattooing of lesions encountered during retrieval DBE might facilitate laparoscopic resection of stenotic segments. (5) Endoscopic removal of the capsule allows magnetic resonance (MR) enteroclysis to be performed, to investigate the remaining small-bowel for additional stenotic segments.^{22, 23}

Although our results indicate that video capsule retention can be resolved with DBE, there still remain several reasons to consider alternatives to VCE in patients at high risk of capsule retention. First, not all centres performing VCE have the opportunity to perform DBE as well. Second, we cannot exclude that DBE might be less successful in the removal of capsules retained in the ileum. In case of suspected stenosis (based on symptoms or radiological imaging) or in case of a significantly increased risk of stenosis (such as in patients with established Crohn's disease) we prefer MR enteroclysis over VCE, or perform DBE directly. Because one case of capsule retention occurred after an uneventful passage of a patency capsule, we do not use the patency capsule regularly.

Our study is limited by its retrospective nature. Therefore, some clinical data, e.g. regarding NSAID use and pre-VCE small-bowel imaging, were not available for all patients in whom retention did not occur. These factors could therefore not be assessed in the total study population. However, detailed clinical data were available for all patients with capsule retention.

An additional limitation is that no ileal retention occurred in our study population. We therefore do not know whether DBE is as successful in retrieving capsules retained in the ileum as it is in retrieving capsules retained in the jejunum. In cases of ileal capsule retention we would have performed antegrade DBE as well. Because we give only two litres of bowel preparation before VCE, and it is not possible to give additional bowel preparation in case of symptomatic capsule retention, retrograde DBE probably has a low chance of success in reaching retained capsules. Additionally, with the retrograde approach, it is possible that in cases of multiple stenoses, a more distal stenosis prevents the endoscope to reach a more proximal stenosis responsible for the retention. It also might be impossible and dangerous to pull a retained capsule distally through the stenosis responsible for the retention.

In conclusion, DBE is a reliable tool to retrieve retained capsules, both in symptomatic and asymptomatic patients. Endoscopic retrieval might prevent unnecessary surgical intervention. Additionally, DBE facilitates histological sampling and endoscopic tattooing of malignant-appearing lesions. This can result in optimal surgical planning and patient preparation, which could result in decreased morbidity and mortality.

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