

Single-balloon enteroscopy following videocapsule endoscopy for diagnosis of the small bowel tumors: preliminary experiences

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Rezumat

Enteroscopia cu un singur balon după endoscopia cu videocapsulă în diagnosticul tumorilor de intestin subțire: experiență preliminară

Introducere și scop: Tumorile de intestin subțire (TIS), benigne sau maligne, sunt rare, reprezentând 3-6% din totalitatea neoplaziilor digestive. Videocapsula endoscopică (VCE) și enteroscopia cu dublu balon (EDB) au revoluționat diagnosticul și managementul pacienților cu afecțiuni ale intestinului subțire, inclusiv al celor prezentând tumori de intestin subțire. Recent s-a dezvoltat o nouă metodă de investigație a intestinului subțire, enteroscopia cu singur balonaș (ESB). Scopul studiului este să prezinte experiența noastră preliminară cu ESB la pacienții cu suspiciune de TIS la investigația cu VCE.

Pacienți și Metodă: Pacienții la care VCE a evidențiat una sau mai multe leziuni sugerând TIS au efectuat ulterior ESB.

Rezultate: Trei pacienți (doi bărbați, o femeie; vârsta medie 52 ± 11 ani) au efectuat ESB, apoi intervenție chirurgicală. Dintre aceștia, doi pacienți au prezentat tumori stromale și un pacient adenocarcinom. Clinic, toți pacienții prezentau anemie feriprivă și dureri abdominale, un pacient prezentând și episoade de greață și vărsături. ESB a fost bine tolerată, fără efecte adverse.

Concluzii: ESB este o investigație sigură, care suplinește limitele VCE. Aceste două metode sunt complementare în investigarea pacienților cu suspiciune de TIS. VCE ar trebui folosită pentru diagnosticul inițial, urmată fiind de ESB

pentru confirmarea anatomopatologică a diagnosticului și, eventual, pentru efectuare de proceduri terapeutice.

Cuvinte cheie: enteroscopie cu un balon, videocapsulă, tumoră, intestin subțire

Abstract

Background and Aim: Small bowel tumors (SBTs), either benign or malignant, are rare, accounting for 3-6% of all digestive neoplasms. Videocapsule endoscopy (VCE) and double-balloon enteroscopy (DBE) have revolutionized the diagnosis and management of patients with small bowel diseases, including SBTs. A novel method using the single-balloon enteroscopy (SBE) has recently been developed. The aim of present study was to present our preliminary experience with SBE in patients with suspected SBTs on VCE examination.

Patients and Methods: Patients in whom VCE showed one or more lesions suggesting SBTs underwent SBE.

Results: Three patients (2 males, 1 female; mean age 52 ± 11 years) underwent SBE, and then surgery. There were two gastrointestinal stromal tumors and one adenocarcinoma. Clinically, all patients had iron-deficiency anemia and abdominal pain, and one patient had episodes of nausea/vomiting. SBE was well tolerated without adverse events.

Conclusions: SBE is a safe procedure and overcomes the limitations of VCE. Both procedures are complimentary in patients with suspected SBTs. VCE should be used first for initial diagnosis, followed by SBE for histopathological confirmation of the diagnosis and, if necessary, endoscopic therapy.

Key words: single-balloon enteroscopy, videocapsule, small bowel tumors

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Introduction

Small bowel tumors (SBTs) are rare, accounting for 3-6% of all digestive neoplasms (1). Most of SBTs are malignant, but they represent only 1.1-2.4% of gastrointestinal malignancies (2). However, the accuracy of these estimates is uncertain because the traditional methodologies for examining small bowel have proved inadequate.

Until a decade ago, most of the small bowel was out of the range of endoscopic examination. The advent of videocapsule endoscopy (VCE) and double-balloon enteroscopy (DBE) is a major breakthrough for the endoscopic diagnosis of small bowel diseases (3). VCE, introduced in practice in 2000, is a safe, painless and accurate endoscopic imaging of the entire small bowel, and several studies revealed its diagnostic superiority over other modalities such as push enteroscopy (4,5), small bowel follow-through (6,7), angiography (8), erythrocyte scintigraphy, CT-enterography, and magnetic resonance imaging (6,9). Nevertheless, VCE lacks the ability to obtain biopsy specimens and perform therapeutic procedures. DBE, invented by Yamamoto et al (10) and introduced in practice in 2001 has also proved an accurate endoscopic method of the entire small bowel (11,12); in addition, this technique allows diagnostic (biopsies) and therapeutic (polypectomy, hemostasis, dilatation of strictures etc) procedures. However, DBE is a complicated invasive procedure, with risk of complications (13). Recently published studies (14-16) showed that VCE and DBE are nearly equal in their ability to detect small bowel lesions if the entire small bowel is examined.

A novel method using single-balloon enteroscopy (SBE) has recently been developed (17,18), which appears to be a simplification of the DBE. Up to now, limited literature is available on SBE, the majority of world's literature on balloon-assisted enteroscopy being focused on the DBE.

We present our preliminary experiences with SBE in patients with suspected SBTs on VCE examination.

Patients and Methods

Patients

Between October 2008 and September 2009, 38 patients (17 males, 21 females; mean age 50 ± 28 years, range 22-78 years) underwent VCE at the Institute of Gastroenterology and Hepatology, Iasi. For each patient in whom VCE showed one or more lesions suggesting SBTs, and a subsequent SBE lead to histological confirmation, the following parameters were registered from their respective charts: clinical presentation, hemoglobin (Hb) level, tumor markers (carcinoembryonic antigen, carbohydrate antigen), small bowel evaluation (upper gastrointestinal endoscopy, colonoscopy, small bowel follow-through, erythrocyte scintigraphy, CT-enterography) before VCE.

Videocapsule endoscopy

The patients underwent bowel preparation with 2 L to 4 L of polyethylene glycol solution and fasted overnight before the procedure. The Given M2A videocapsule (Pillcam SB,

Given Imaging Ltd, Yoqueam, Israel) was swallowed with 200 ml water by the patients after a sensor array was applied to their abdomen and connected to the data recorder which they wore on a belt. Patients were allowed to drink clear liquids at 3 hours after swallowing the videocapsule. All equipment was disconnected after 8 hours, and the images was downloaded and reviewed by two experienced reviewers. The location of the lesions in the small bowel were determined by the time ratio, which was calculated by the transit time from the pylorus to the lesion divided by the transit time from the pylorus to the caecum.

Single-balloon enteroscopy

SBE was performed by using an Olympus system (Olympus Medical Systems Europa GmbH, Hamburg, Germany) which consists of a high-resolution video enteroscope (SIF-Q180), a flexible overtube (ST-SB1) with a silicon balloon attached at its tip, and a pressure-controlled pump. The high-resolution enteroscope is 200 cm long, with an outer diameter of 9.2 mm. The working channel of the enteroscope has a diameter of 2.8 mm. The flexible overtube is made of silicon, and has a working length of 132 cm and an outer diameter of 13.2 mm.

As we used only antegrade approach, no specific preparation was required, patients being instructed, just as for an upper gastrointestinal endoscopy, to be fasted for at least 8 hours before the procedure. The examination was carried out with the patient under conscious sedation under the monitoring and care of an experienced anesthetist. The patient's position during enteroscopy was prone in all cases, and the overtube was lubricated with 10-20 ml of saline before insertion of the enteroscope. The balloon on the tip of the overtube was deflated at the start of the procedure, until the second or the third part of the duodenum was reached. The balloon was then inflated to fix the overtube to the intestine and to maintain a stable position, while the tip of the enteroscope was advanced as far as possible into the deep part of small intestine. Then, the tip of the enteroscope was bent to fix to the intestine, and the overtube with the deflated balloon was slowly inserted along the enteroscope until reached the endoscope tip. The overtube balloon was then inflated again, and pulled back together with enteroscope in order to shrink the bowel, which was folded over the overtube into concertina like fashion. Then, the enteroscope was once again threaded into the small bowel. By repeating this process, the enteroscope was inserted deeper into the small intestine. Depth of insertion of the enteroscope was estimated by calculating the sum of each sequential progressive extension of the scope through the overtube, starting the calculation from the duodenojejunal flexure onwards. Advance of the scope was stopped when the tumor was reached. All procedures were performed by two experienced endoscopists.

All patients provided written consent prior to undergoing SBE.

Results

All patients swallowed the videocapsule without difficulty,

and the procedure was well tolerated without adverse events. SBTs were suspected in three out of 38 patients (7.8%) submitted to VCE. All three patients (2 men, one women, mean age 52 ± 11 years, range 41-63 years) with suspected SBTs on VCE underwent single-balloon enteroscopic procedures. Clinically, all patients presented with obscure gastrointestinal bleeding which was obscure-occult in two patients and obscure-overt in one patient. The patient with overt bleeding had melena and symptoms related to anemia, and no other complains. By contrast, patients with occult bleeding had abdominal pain and repeated episodes of nausea/ vomiting. Mean Hb level at presentation was $9.4 \pm 0,7$ g/dl. CEA and CA 19.9 were available in two patients and only one patient had abnormal levels of both tumoral markers. Characteristics of the patients are summarized in Table 1.

All patients underwent VCE after at least one negative upper gastrointestinal endoscopy and colonoscopy. Procedures aimed to evaluate the small bowel (small bowel follow-through, angiography, CT-enterography, erythrocyte scintigraphy) had also been performed before VCE. The mean number of diagnostic procedures performed (including upper gastrointestinal endoscopy and colonoscopy) before VCE was 4.6/ patient; in two patients the results of these examinations were completely negative, while erythrocyte scintigraphy suggested active bleeding in one patient.

The following endoscopic appearances of SBTs on VCE were described: small polypoid lesion with central depression, polypoid ulcerated lesion, active bleeding, bluish protruding lesion.

The entire small bowel was examined by VCE in all three patients.

SBE was performed without any complications; two patients have complained of sore throat. The mean duration of the procedure was 59 minutes (range 45-68 minutes).

Table 1. Characteristics of the patients with small bowel tumors

Characteristics	Patients
Age (years)	
Mean	52 \pm 11
Range	41-63
Male/ female	2/1
Hemoglobin (g/dl)	
Mean	9.4 \pm 0.7
Range	8.7 - 10.1
Occult GI bleeding of obscure origin	
Iron-deficiency anemia	1
Positive fecal occult blood test	1
Overt GI bleeding of obscure origin	
Melena	1

Biopsy specimens were obtained for histopathological diagnosis and surgery was performed in all patients. The final diagnosis was gastrointestinal stromal tumors (GISTs) in two patients and an adenocarcinoma in one case.

The patient with adenocarcinoma had a bleeding polypoid mass in the proximal jejunum on VCE, confirmed on SBE (Fig. 1A,B) with biopsy and then at surgery. Patients with GISTs presented on VCE jejunal polypoid ulcerated lesion (Fig. 2A) and jejunal submucosal protruding lesion (Fig. 3A), which were confirmed on SBE as polypoid lesions located in the jejunum (Fig. 2B, 3B), the final diagnosis being established by histopathological examinations of biopsy specimens, and then at surgery (Fig. 2C).

Discussion

Our initial experiences with SBE has shown that this procedure is safe and accurate for the final diagnosis of SBTs

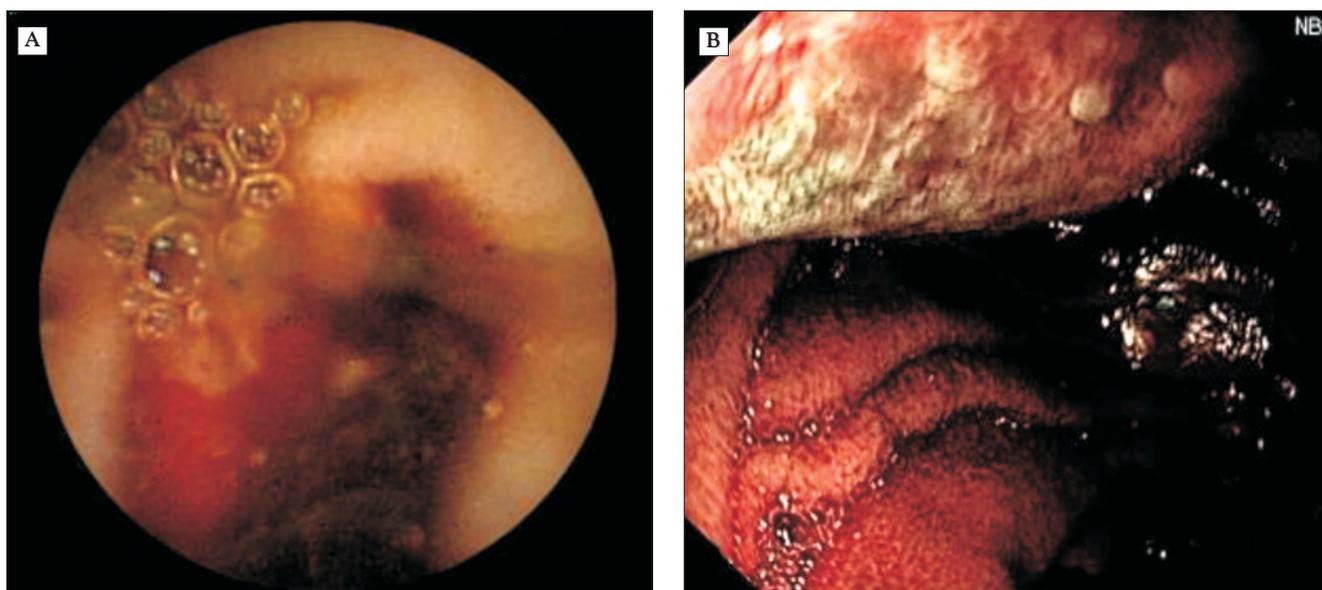


Figure 1. (A) VCE shows a jejunal bleeding polypoid mass; (B) SBE shows a jejunal polypoid lesion (narrow band imaging)

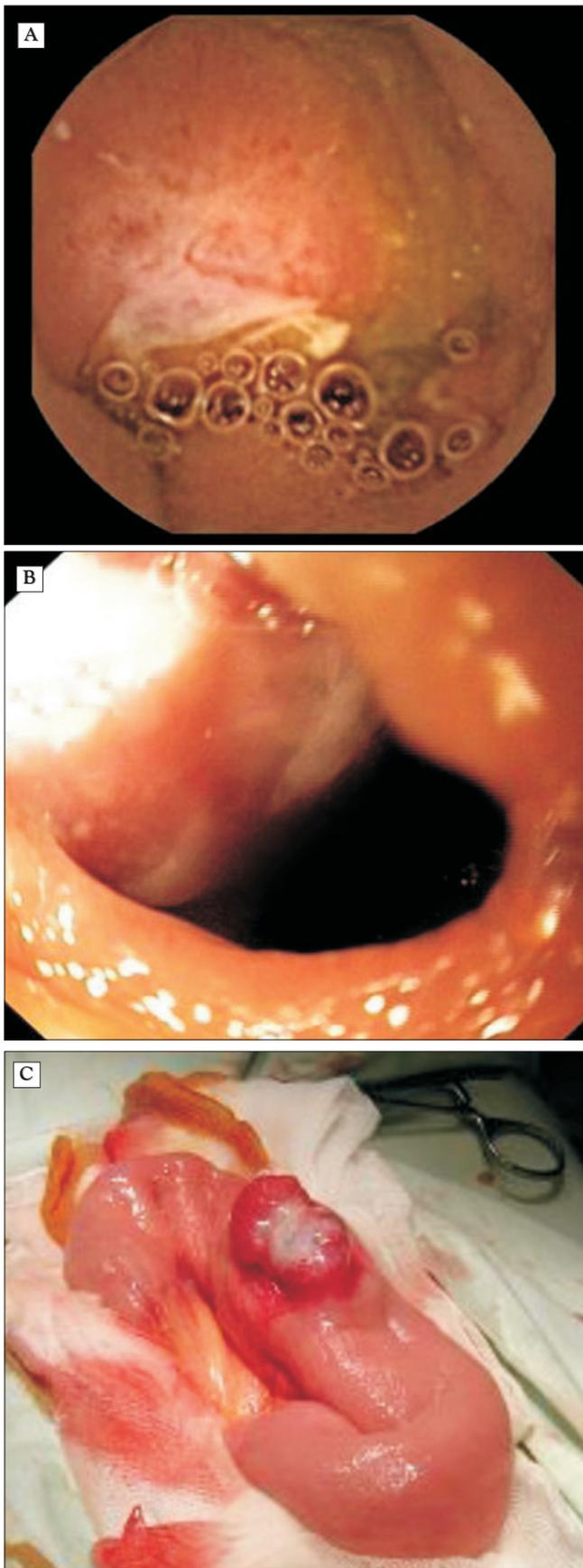


Figure 2. (A) VCE shows a jejunal ulcerated mass; (B) SBE shows an irregular jejunal polypoid lesion; (C) Surgery: ulcerated jejunal tumor

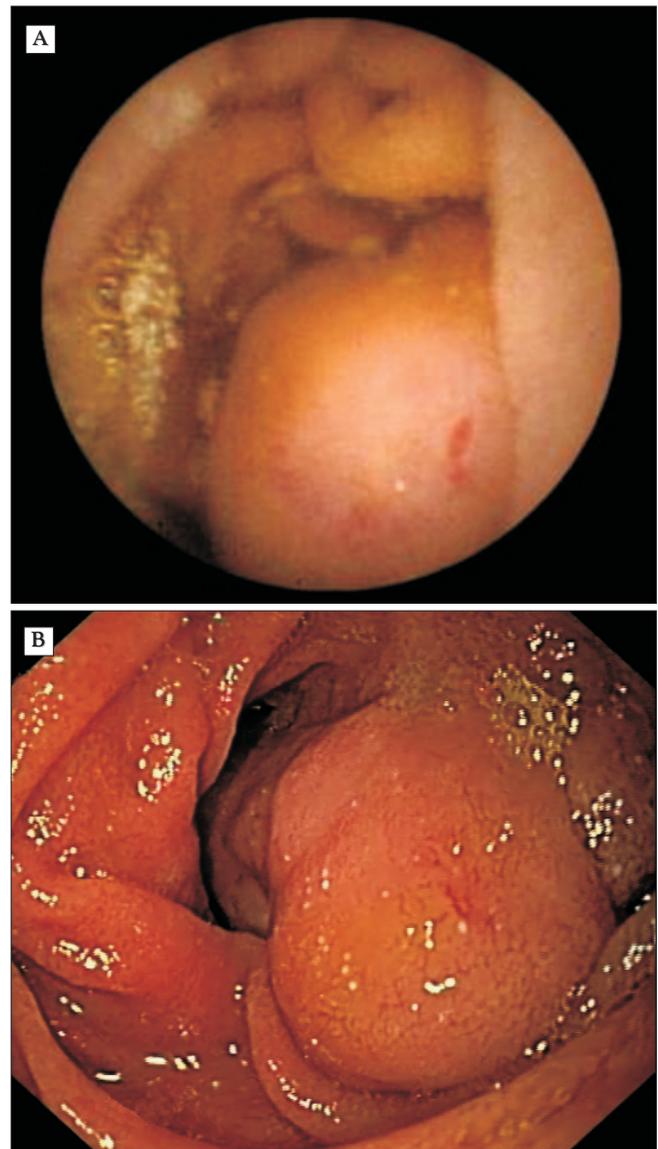


Figure 3. (A) VCE shows a jejunal submucosal mass; (B) SBE shows a polypoid mass in proximal jejunum

suspected on VCE. We have performed VCE on 38 patients during a 12-month period, and three of them had lesions suggesting SBTs. All three patients with suspected SBTs on VCE underwent SBE which was performed without any complications. There were two patients with GISTs and one patient with adenocarcinoma, the final diagnosis being confirmed by biopsy specimens obtained during SBE and then at surgery. Of course, our study has several limits, the most important being the small number of patients undergoing SBE. However, the prevalence of SBTs (7.8%) in this study is higher than previously reported in our region.

Small bowel tumors (SBTs) are very rare in comparison to other neoplasms of the gastrointestinal tract. Thus, SBTs represents only 1.1-2.4% of all gastrointestinal malignancies (2) which is striking low when one considers that the small bowel represents 90% of the mucosal surface area of the

alimentary tract and 75% of its length. Even more, the low incidence of SBTs is especially interesting when one considers that small bowel lies between stomach and colon, two organs whose cancer incidence is very high. However, this low incidence of SBTs might not be accurately estimated because of their nonspecific symptoms combined with inadequate methodologies for examining small bowel. Historically, endoscopic examination of the small bowel was difficult and completely inadequate because of its significant length, contractility, and overlying loops. Since the introduction of VCE and DBE into clinical practice, several studies have suggested that the prevalence of these tumors may be substantially higher than previously reported (19-25).

Until 10 years ago, most of the small bowel was out of the endoscopic examination. The advent of CE and DBE are major breakthroughs for the endoscopic diagnosis of small bowel diseases, both methods allowing endoscopic imaging of the entire small bowel.

VCE is a relatively patient-friendly, painless, noninvasive and safe method of endoscopic examination of the small bowel, and could be performed on an outpatient basis; it has the advantage of total small bowel visualization during a single examination. Currently, VCE is manufactured by several companies (Pillcam SB, Given Imaging Ltd, Yoqneam, Israel; Olympus Endovideocapsule from Olympus, Japan; OMOM videocapsule endoscope from Jinshan Science and Technology Group, Chongqing, China; MIRO CAM, IntroMedic, Seoul, Korea etc). Recently, two comparative studies (26,27) did not demonstrate significant differences regarding diagnostic yield between the Given videocapsule and Olympus videocapsule in patients with obscure gastrointestinal bleeding.

Since its introduction in practice (2000), VCE has proved to be an accurate endoscopic examination of the entire small bowel, and several studies have revealed its diagnostic superiority over other procedures aimed to evaluate the small bowel such as push enteroscopy (4,5), small bowel follow-through (6,7), angiography (8), erythrocyte scintigraphy, computed tomographic enterography, and magnetic resonance enterography (6,9). Consequently, VCE has been accepted as a standard practice in investigating diseases of the small bowel, including SBTs.

Recently, several studies (14-16) reported that VCE and DBE are nearly equal in their ability to detect small bowel lesions if the entire small bowel is examined. Nevertheless, VCE lacks the ability to obtain biopsy specimens and perform therapeutic procedures (polypectomy, electrocauterisation).

VCE provides useful information on the indications and selection of the right insertion route for deep enteroscopy. A group of international experts, in a consensus statement, recommended that VCE should be performed before DBE (14,16). Balloon-assisted enteroscopy should be performed in all patients in whom SBTs detected by VCE are thought to require biopsy or endoscopic treatment. With the increasing use of VCE, the need for enteroscopy (DBE, SBE, spiral enteroscopy) also will increase.

DBE was invented by Yamamoto et al (10) and introduced in practice in 2001, and is based on the combined use of a

balloon-loaded enteroscope and a balloon-loaded overtube. Alternately inflating and deflating the balloons and straightening the endoscope with the overtube achieves a stepwise progression of the enteroscope throughout the small bowel. DBE system (Fujinon, Inc., Japan) consists of a high resolution videoendoscope with a working length of 200 cm and an outer diameter of 8.5 mm or 9.4 mm, with an attachable latex balloon at its tip, and a flexible overtube with an outer diameter of 12 mm and a length of 145 cm with a latex balloon at the distal end. The balloons can be inflated and deflated by using a pressure controlled pump system. The inflated balloon on the overtube is used to maintain a stable position while the enteroscope is advanced. The overtube balloon is deflated whilst the enteroscope balloon is inflated, and the overtube is advanced along the distal end of the enteroscope. Then both the overtube and the enteroscope are pulled back under endoscopic guidance, with both balloons inflated. This procedure is repeated several times to visualize entire small bowel (10,28).

The procedure can be performed under conscious sedation and general anesthetic, and the average time for per-oral or per-anal approaches is 75 min (29). The insertion route is chosen according to the location of suspected lesion. Combination of the oral and anal approach allows visualisation of the majority of the small bowel, total enteroscopy is not achieved in many cases (30). Endoscopic interventions (mucosal biopsy, argon plasma coagulation, polypectomy, balloon dilatation) can be performed under DBE. However, DBE has several limitations: complicated procedure, limited availability, invasive, with risk of complications (perforations, pancreatitis).

Kameda et al (31) in a prospective trial comparing VCE and DBE in patients with obscure gastrointestinal bleeding found the superiority of VCE in detecting abnormal lesions and a higher rate of complete small bowel examination, and the superiority of DBE in endoscopic diagnosis and treatment. The two methods are thus complimentary in diagnostic evaluation of the entire small bowel. Pasha et al (32) in a recent meta-analyse report that VCE and DBE had comparable diagnostic yield in small bowel disease. Similar results have been reported by other studies (14,15).

SBE (Olympus Optical Co., Tokyo, Japan) has emerged as an alternative to DBE, and was introduced into commercial market in 2007 (17,18). Technically, it is easier to perform when compared with DBE, and can be performed by a single endoscopist. However, SBE is invasive, requires the use of sedation, with risk of complications. Up to now, there is a limited literature available on the SBE (33), the majority of published studies being focused on DBE (34). Tsujikawa et al (35) have performed 80 SBE procedures on 41 patients, with a mean procedure time of 62.3 minutes for oral route and 70.2 minutes for anal route; the rate of complete enteroscopy was 46% among the patients who did not have any intestinal stenosis and adhesions, and the authors concluded that SBE was a safe and feasible diagnostic and therapeutic procedure for small bowel disorders. Ramchandani et al (36) in a prospective

study have evaluated the feasibility, complications, diagnostic and therapeutic yield of SBE in patients with suspected small bowel disorders and found that SBE had good diagnostic yield, similar to previous DBE reports. Comparative studies between SBE and DBE were necessary to evaluate their diagnostic yield and ability to examine the entire small bowel. And the first such study has just been published by May et al (37) who reported in a prospective multicenter trial that with DBE the rate of enteroscopy had been three fold higher than with SBE and, in addition, DBE had a higher diagnostic yield.

In conclusion, from our preliminary experiences, the SBE appears easy to use, safe, and efficient for final diagnostic approach of SBTs suspected on VCE. In patients suspected of SBTs, VCE should be used first for the initial diagnosis, followed by SBE for histopathological confirmation of the diagnosis and, if necessary, endoscopic therapy.

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