

Double Balloon Enteroscopy: a 2 Year Experience

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ABSTRACT: **Background:** Double balloon enteroscopy is a new technique that enables deep intubation of the endoscope into the small bowel lumen. Through a channel in the endoscope, invasive procedures such as biopsy, polypectomy and hemostasis can be performed, avoiding the need for surgery.

Objectives: To prospectively analyze our results of the first 124 DBEs performed since February 2007.

Methods: The study group comprised all patients who underwent DBE at the Sheba Medical Center between February 2007 and February 2009. Recorded were the patients' demographic data, comorbidities, indications for the examination, results of previous non-invasive small bowel imaging (computed tomography enterography, capsule endoscopy, etc), investigation time, and results of the procedure including findings, endoscopic interventions, complications and pathological report.

Results: A total of 124 procedures were performed in 109 patients. Of the 124 examinations, 57 (46%) were normal and 67 (54%) showed pathology. The main pathologies detected on DBE were polyps (14%), vascular lesions (17.6%) and inflammation (12%). Endoscopic biopsies and therapeutic interventions were required in 58 examinations (46%). A new diagnosis was established in 15% of patients, diagnosis was confirmed in 29% and excluded or corrected in 12%. One complication was observed: a post-polypectomy syndrome that was treated conservatively.

Conclusions: DBE is a safe procedure and has a high diagnostic and therapeutic yield. Most of the examinations were performed under conscious sedation, and only a minority of patients required deeper sedation.

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graphic imaging of the small bowel [1,2]. However, this new technology, with its additional intraluminal findings, emphasized the necessity for an invasive device with options to perform endoscopic interventions. Double balloon enteroscopy, developed by Yamamoto et al. [3], responded to this need. By using inflation and deflation of two balloons placed on the endoscope and an overtube, this new technique enables deep intubation of the endoscope into the bowel lumen. Through a channel in the endoscope, invasive procedures such as biopsy, polypectomy and hemostasis can be performed, obviating the need for surgery.

In a literature search we found that most data on DBE come from Japan and Europe [3-6]. Our center is currently the only medical center in Israel where this new technology is available. In this study we prospectively analyze our results of the first 124 DBEs performed since February 2007.

PATIENTS AND METHODS

All patients who underwent DBE at the Sheba Medical Center between February 2007 and February 2009 were included in the study. Patients' demographic data, comorbidities, indications for the examination, results of previous non-invasive small bowel imaging (computed tomography enterography, capsule endoscopy, etc), investigation time and results of the procedure including findings, endoscopic interventions, complications, and pathological report were recorded.

The examination was performed using the 9.5 mm enteroscope Fujinon EN-450T5; t-type (Fujinon Inc, Saitama city, Japan). The procedure was performed using the technique described by Yamamoto et al. [3]. Briefly, the Fujinon double balloon endoscopy system consists of a 200 cm endoscope, a 145 cm long overtube, and a pump. Two latex balloons are attached to the system: one to the tip of the endoscope and the other to the overtube. The balloons are inflated and deflated using the pump. The examination begins with the overtube back-loaded on the endoscope with both balloons collapsed. The endoscope is advanced into the bowel lumen until no further advancement is possible. The balloon on the tip of the endoscope is then inflated. This is followed by inserting the overtube into the lumen and inflating the overtube balloon. Using the overtube as an anchor, the balloon of the endoscope is deflated and the endoscope is advanced deeper

Until a few years ago the small bowel was hidden from direct optic inspection, mainly due to its length and anatomic position. With the introduction of new modalities full inspection of the small bowel has become feasible. The first tool was capsule endoscopy that enables full-length photo-

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DBE = double balloon enteroscopy

into the small bowel. Thus, by inflating and deflating the two balloons the endoscope is advanced along the small bowel. The examination is terminated when the lesion is reached, or when no further advancement is possible.

The approach (oral or anal) was determined by the endoscopists according to the assumed location of the lesion, which was the indication for the examination. If endoscopy through one route did not reach the lesion, or if there was a specific clinical indications (see below), enteroscopy through both routes was performed.

Four experienced endoscopists (each with more than 5 years experience in endoscopic practice) performed all the procedures, working first in pairs. Once experience, was gained, the procedures were performed by one examiner.

Sedation was achieved using midazolam and meperidine in increasing doses up to 10 mg and 150 mg, respectively. In 29 patients, mostly according to patient's preference, propofol was given by an anesthetist in doses up to 1200 mg.

RESULTS

PATIENTS' CHARACTERISTICS AND INDICATIONS FOR DBE

Between February 2007 and February 2009 a total of 124 procedures were performed in 109 patients. Ninety-eight patients underwent one procedure, 11 patients underwent two procedures and one patient (with Peutz-Jaeger syndrome) underwent four procedures. Forty-three of these patients were women and 66 were men. The mean age was 55.5 ± 19.4 years (range 15–86 years). Patients' mean hemoglobin level prior to the examination was 11.1 ± 4.7 g/dl (range 5–16 g/dl). All patients underwent the procedure as outpatients.

Indications for the examination are shown in Tables 1 and 2. The indications were divided into two major categories: the clinical indication, which usually initiated the diagnostic workup, and the imaging/endoscopic indication, which prompted DBE as a result of previous diagnostic procedures. Thus, most patients had more than one indication.

PRIOR ENDOSCOPIC EVALUATION

Eighty-nine patients underwent a complete colonoscopy before the DBE. A full colonoscopy prior to the examination was not performed in 15 patients: in one a prior colonoscopy failed, and in two other patients colonoscopy did not reach the cecum. Findings on colonoscopy included diverticulosis in 8 patients (4.2%), polyps in 16 (14.6%), hemorrhoids in 1 (0.9%), arteriovenous malformations in 2 (2.3%), blood

in colon/terminal ileum in 3 (3.4%), ileal ulcer in 1 patient (1.1%), cecal petechia in 1 (1.1%), carcinoid in 1 (1.1%), and carcinoma in 1 patient (1.1%).

An upper gastrointestinal endoscopy was performed prior to DBE in 94 patients and was normal in 64 patients (59%). The findings on gastroscopy included gastritis in 12 patients (11.0%), polyps in the stomach and/or the duodenum in 7 (6.4%), arteriovenous malformations in 2 (1.8%), esophagitis in 1 (0.9%), Barretts' esophagus in 1 (0.9%), blood in stomach in 1 (0.9%), duodenitis in 1 (0.9%), gastric erosions in 2 (1.8%), hiatal hernia in 2 (1.8%) and gastric ulcer in 1 patient (0.9%).

Push enteroscopy was performed prior to DBE in 25 patients (23%). The examination was normal in 15 patients (13.7%). Arteriovenous malformations were found in 7 patients (6.4%) and polyps in 3 patients (2.7%).

TECHNICAL ASPECTS OF DBE

Of the 124 procedures 79 were performed through the oral route and 45 through the anal approach. Ninety-seven patients underwent one procedure (65 oral and 33 anal), 11 patients underwent the procedure from both the anal and oral route, and one patient with Pautz- Jeuger's disease underwent four procedures – three from the oral and one from the anal approach in order to resect polyps. In only one procedure performed through the anal approach (0.8%) could the small bowel not be reached.

The mean procedure duration was 59.1 ± 26 minutes (range 23–120 min) for all DBEs. The mean examination time for the oral approach was 53.3 ± 22.5 minutes (range 23–120 min), and for the anal approach 72.3 ± 28.8 minutes (range 30–120 min). The mean procedure duration for the first 40 oral examinations was 57 ± 23 minutes, and for the next 39

Table 2. Imaging/endoscopic indication indications for DBE

Abnormal* CT, MRE/ plain abdominal radiography	Abnormal CE**	Retained CE	Abnormal*** push enteroscopy/ gastroscopy
38 (35%)	61 (56%)	1 (0.9%)	2 (1.8%)

*Abnormal findings on CT/MRE included masses, strictures and thickened bowel wall in the small intestine. The abnormal plain abdominal radiography showed dentures in the small bowel

**Abnormal findings on CE included overt bleeding, polyps, submucosal lesions, intussusception, arteriovenous malformations, mucosal inflammation with or without erosions and ulcerations

***Abnormal finding at gastroscopy was a polyp in the duodenum that was resected by DBE. Abnormal findings in push enteroscopy were multiple arteriovenous malformations in the small bowel that were treated with coagulation during DBE

MRE = magnetic resonance enterography, CE = capsule endoscopy

Table 1. Clinical indications for DBE

Foreign body	Diarrhea	Susp Crohn's disease	Bowel obstruction	Vomiting	Abdominal pain	Rectal bleeding/melena	Anemia
1 (0.9%)	5 (4.6%)	1 (0.9%)	1 (0.9%)	4 (3.7%)	14 (13%)	9 (8%)	50 (46%)

Values are number and percent of patients

Table 3. Findings in the small bowel on DBE

Findings	Patients	Details (no. of patients)
Normal	52 (48%)	
Polyps	16 (14%)	Hamartoma (2; 1 Peutz-Jeghers syndrome), leiomyoma (3), juvenile (2), inflammatory pseudopolyps (4), hyperplastic (4), normal mucosa (1)
Tumors	6 (7%)	Lipoma (3), lymphoma (1), adenocarcinoma (2)
Vascular lesions & overt bleeding	19 (17.6%)	AVM (13), petechia (1), active bleeding (2), coffee grounds (1), prominent blood vessel (2)
Inflammation	13 (12%)	Inflammatory mass (1), ulceration (10), erosions (2).
Miscellaneous	2 (1.8%)	Denture (1), anastomosis (1)

AVM = atriovenous malformations

Table 4. Diagnostic yield of DBE

Diagnostic yield of DBE*	Patients	Details (no. of patients)
New diagnosis	16 (15%)	Adenocarcinoma (2), lymphoma (1), AVM (2), lipoma (3), duodenal ulcer (1), a fold at anastomosis (1), prominent blood vessel (1), inflammation (3), bleeding blood vessel (1)
Conformation of diagnosis	31 (28%)	Polyps (10), Crohns disease (5), AVM (12), adenocarcinoma (1), lipoma (1), inflammation (1), dentures (1)
Exclusion/correction of diagnosis	13 (12%)	Suspected polyps (4), suspected thickened bowel wall (7), suspected enteritis (1), suspected tumor (1)
Normal examination	49 (45%)	

* More than one diagnosis is possible for each patient

procedures the duration was 49.7 ± 20 (not significant). The mean procedure duration for the first 23 procedures via the rectum was 72.2 ± 30 minutes, and 64 ± 30 minutes for the other 22 procedures (not significant).

FINDINGS AND INTERVENTIONS

Of the 124 examinations, 57 (46%) were normal and 67 (54%) showed pathology. Four patients underwent the procedure from both the mouth and the rectum with no pathological findings. Five patients who had a normal examination had a repeat DBE from the other approach and were found on the second examination to have pathology in the small bowel. The pathological findings on DBE in the small intestine are summarized in Table 3. Findings that can be interpreted as normal variants (e.g., lymphoid hyperplasia) were not included in the Table.

Endoscopic biopsies and therapeutic interventions were required in 58 examinations (46%). These interventions included: polyp resection in 16 examinations, biopsies in 26, coagulation and hemostasis in 15, and removal of dentures in 1. In 24 procedures tattooing was performed; in 6 the purpose was to mark pathology, and in the 18 the intent was to mark the depth of insertion.

DIAGNOSTIC YIELD

The diagnostic yield of DBE was assessed by comparing the findings of DBE to the findings of other diagnostic modalities such as capsule endoscopy, CT enterography, small bowel follow-through, gastroscopy and colonoscopy. Results are shown in Table 4.

COMPLICATIONS

Only one complication was observed. Notably, no complication occurred after diagnostic procedures. The only complication occurred after a resection of a 7 mm sessile polyp. Several hours after the procedure the patient developed abdominal pain, fever and leukocytosis. On examination the abdomen was tender. No free air was seen on abdominal CT. The patient was diagnosed as having post-polypectomy syndrome and was treated conservatively with intravenous antibiotics and bowel rest. He was discharged after 5 days of hospitalization. No other major complications that necessitated hospitalization were observed.

DISCUSSION

Our results clearly emphasize the advantages of DBE. Though all patients underwent a previous workup that included at least one endoscopic procedure, small bowel imaging and in most patients capsule endoscopy as well, a new pathology was detected in 15%. Moreover, an already established diagnosis was either excluded or changed in 12% of patients and confirmed in another 29%.

DBE had a therapeutic role in three types of lesions, namely removal of polypoid lesions, treatment of atriovenous malformations with coagulation, and removal of a foreign body.

Our diagnostic yield of small bowel pathology (55%) is similar to previous reports in the literature [13]. Other studies, however, reported a higher diagnostic yield of 80% [7,8]. The higher diagnostic yield may be the result of a more strict patient selection.

Technically, the mean procedure duration was approximately one hour for both the anal and rectal approach. This result did not change significantly with the increase in experience, though there is a non-statistically significant tendency towards reduced examination duration as experience was gained. Procedure duration was similar to that reported from Europe and Japan [4-7]. The fact that the length of the procedure did not significantly decrease with the increase in experience was reported by others as well [8]. The conscious sedation that was used for most of our patients was sufficient and achieved good analgesia. However, in 29 examinations (of which 90% were performed through the oral approach), anesthesia with propofol was used. The use of conscious sedation in most of our patients is similar to most of the reports in

the literature [7,9-12]. In contrast to one article [8], we did not find that general anesthesia with endotracheal intubation was needed. In one procedure performed from the anal approach the small bowel could not be reached. The procedure was the third examination performed from the anal approach and it might be related to our learning curve. Still, our failure rate is lower than that reported in the literature (8–31%) [7,13].

The pathologies we found in the small bowel during DBE are similar to those reported [7-12]. In our patients the main indication for the DBE was anemia and the most common pathology was a vascular lesion.

Endoscopic therapeutic and/or diagnostic interventions were performed in 45% of the procedures. This number is lower than that in other studies, which performed endoscopic interventions in 6–72% of the procedures [8,13]. This difference is related to the lower diagnostic yield in our study.

In our study, as in many others, DBE was shown to be a safe procedure with a small complication risk [4,6-15]. Though some patients did have minor abdominal discomfort after the procedure, these complaints soon subsided. Only one patient required hospitalization for post-polypectomy syndrome. This patient was treated conservatively.

In conclusion, we have shown that DBE is a safe procedure with a high diagnostic and therapeutic yield. Most of the examinations were performed under conscious sedation, and only a minority of patients required deeper sedation.

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