

## Enteroscopy-guided Contrast Radiography of Small Bowel Lesions<sup>1</sup>

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**Purpose:** To introduce the method of enteroscopy-guided contrast radiography (ECR) and evaluate the diagnostic value of ECR for those patients with small bowel lesions.

**Materials and Methods:** From Aug 2004 to Dec 2005, 43 double-balloon enteroscopy (DBE) examinations were performed in 32 patients with suspected small bowel diseases. Among them, DBE revealed abnormal finding in 24 patients, and ECR was then performed in 13 of these 24 patients.

**Results:** ECR demonstrated abnormal findings in 11 among the 13 patients. In the cases of tumors and bezoar, the ECR images were very helpful for the surgical planning. However, for the evaluation of inflammatory lesions, DBE showed more accurate results and ECR could not demonstrate small or shallow ulcerative lesions.

**Conclusion:** ECR can be helpful for surgical planning or determination of treatment effect in the cases of small bowel lesions that require surgical treatment or follow-up study.

**Index words :** Intestine, radiography  
Intestine, diseases  
Endoscopy  
Gastrointestinal tract, radiography

The small bowel is one of the most difficult parts of the gastrointestinal tract to evaluate because of its long length, complex looped configuration, and also because of its distant location. Only the proximal portion of the jejunum and the terminal ileum can be examined with the use of upper gastrointestinal endoscopy and colonoscopy. Thus, other examination tools such as small bowel follow-through, enteroclysis, capsule endoscopy and double-balloon enteroscopy are used to

evaluate entire small bowel loops.

Recently, double-balloon enteroscopy (DBE), a new method that allows visualization of entire small bowel, is being frequently used in clinical settings. It also enables to take biopsy specimens, therapeutic interventions and contrast radiography. In our department, we introduced enteroscopy-guided contrast radiography (ECR) of small bowel lesions by injecting water-soluble contrast medium via a side hole of the enteroscope.

The aim of this prospective study was to evaluate the usefulness of ECR and to demonstrate the ECR finding of various small bowel lesions.

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Received June 29, 2006 ; Accepted August 31, 2006

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## Subjects and Methods

### Clinical data

From Aug 2004 to Dec 2005, 43 DBE exams were performed in 32 patients for a variety of indications at our hospital. The DBEs revealed abnormal findings in 24 patients. Among them, ECR was performed in 13 patients (seven female six male, mean age: 48 years, range: 20 - 83 years) who had small bowel lesions that caused mucosal change or contour abnormality.

The diseases included were as follows; eight inflammatory diseases (four Crohn's diseases, one tuberculosis, one nonsteroidal anti-inflammatory drug induced ulcer and two non-specific ulcers), three tumorous lesions (one metastasis from gastric cancer, one hemangioma and one lipoma), one jejunal bezoar and one case of jejunal diverticuli. The DBE and ECR findings are summarized in Table 1.

The final diagnosis was confirmed by the pathologic results obtained following surgery or endoscopic biopsy sampling, except for one patient who had jejunal diverticuli.

### Double-balloon Enteroscopy (DBE)

The DBE system consists of a video enteroscope (Fujinon EN-450 P5/20; Fujinon Inc, Saitama, Japan) and a flexible overtube. Latex balloons are attached at the tip of the enteroscope and the overtube, and they are inflated

and deflated using a specially designed air pump controller (Fujinon PB-10). The DBE was inserted via either the oral or anal approach depending upon our suspicion for the location of the responsible lesion. If one of the ways showed no demonstrable lesion, then DBE via the other approach was also performed.

The oral approach required no specific preparation, but the anal approach required bowel cleansing. The procedure was done under conscious sedation and general anesthesia was not necessary.

The enteroscopic procedures were done by a gastroenterologist and the results for our study were obtained from the enteroscopic reports and admission charts.

### Enteroscopy-guided Contrast Radiography (ECR)

The DBE examinations were performed in a fluoroscopy room and all the ECR images were obtained with using a digital fluoroscopic unit (Shimadzu XUD 150B-30; Shimadzu, Kyoto, Japan). During the DBE procedure, fluoroscopy was used for identifying the location of the enteroscope.

ECR was performed when DBE or other radiologic modalities revealed abnormal findings in the small bowel. We first placed the enteroscope as near as possible to the lesion. Then, the two latex balloons at the tip of enteroscope and the overtubes were inflated to prevent regurgitation of contrast media. Water-soluble contrast media (Gastrografin; Schering, Berlin, Germany) and air were injected via a side hole of the enteroscope to evalu-

**Table 1.** Summarization of the DBE and ECR Findings

No.	Sex	Age	Diagnosis	Pathologic Diagnosis Method	DBE Finding	ECR Finding
1	F	33	Crohn's disease	DBE with biopsy sampling	Focal stricture	Focal stricture with mild passage delay
2	M	26	Crohn's disease	DBE with biopsy sampling	Erosions and strictures	Strictures
3	F	26	Crohn's disease	DBE with biopsy sampling	Ulcers and strictures	Ulcers and strictures
4	F	45	Crohn's disease	DBE with biopsy sampling	Ulcers	Negative
5	M	58	Tuberculosis	Surgery	Ulcers and strictures	Strictures
6	F	58	Nonsteroidal anti-inflammatory drug induced ulceration	Surgery	Ulcer and stricture	Focal stricture
7	F	49	Non-specific chronic inflammation	DBE with biopsy sampling	Ulcers	Negative
8	M	20	Ulcer	Surgery	Ulcers	Bowel dilatation
9	F	57	Metastasis from stomach cancer	Surgery	Irregular narrowing	Irregular narrowing
10	M	43	Hemangioma	Surgery	Irregular narrowing	Irregular narrowing
11	F	51	Lipoma	Surgery	Submucosal tumor	Submucosal tumor
12	F	83	Bezoar	Surgery	Negative*	Large filling defect
13	M	75	Jejunal diverticuli with bleeding	NA <sup>†</sup>	Jejunal diverticuli with bleeding	Jejunal diverticuli

\* DBE failed to reach the lesion site, <sup>†</sup>Not available

ate the lesion, and the single or double contrast images were obtained. All the ECR images were conducted by a radiotechnologist; evaluation of the images was done by two board-certified radiologists.

## Results

The DBE and ECR findings are summarized in (Table 1). ECR revealed abnormal findings in 11 of the 13 patients. All three tumorous lesions could be found by both DBE and ECR. In a patient with bezoar in the jejunum, DBE via the anal route failed to reach the lesion site, but ECR was able to demonstrate the lesion (Fig. 1). In these 3 cases, the ECR images were more helpful in determining the lesions' size and location for surgery.

However, DBE showed the more accurate results for evaluation of the inflammatory lesions. ECR could not demonstrate small or shallow ulcerative lesions as compared to DBE. In three of eight patients with inflammatory lesions, ECR could not demonstrate ulcers that were detected by DBE.

## Discussion

Small bowel disease is relatively rare and difficult to evaluate, but the medical evaluation of small bowel is necessary in a situation where there is suspected bleeding or obstruction in the small bowel loops (1). Currently, the most common tests for small bowel evaluation are radiologic studies such as small bowel follow-through (2). Radiologic studies are relatively easy and comfortable for patients, but the accuracy varies widely among different radiologists and institutions. In general,

the diagnostic value of small bowel follow-through and enteroclysis is not satisfactory (2 - 4).

Endoscopic examination of the small bowel using capsule endoscopy (CE) and DBE has now been introduced. First, CE offers complete endoscopic evaluation of the small bowel loops. It works as it moves along the gastrointestinal tract via peristalsis. The prime advantage of CE is that it causes minimum discomfort to subjects. CE procedures do not need sedation or any other medication, or confinement in a hospital. However, CE also has several limitations. Because it is based on the analysis of recorded images, more detailed observations of a particular site cannot be conducted even if an abnormality is suspected. Even more, it may pass a lesion without recording an image. The fact that biopsy or endoscopic treatment cannot be performed is another limitation of CE. CE is contraindicated in those patients with gastrointestinal stenosis because of the risk of retention. Therefore, it is recommended that the possibility of stenosis should be excluded by contrast radiography of the small intestine prior to performing CE (5 - 9).

Several years ago, Yamamoto H et al. developed DBE systems based on a new insertion theory that makes it possible to insert an endoscope into the distal portion of the small bowel (10 - 12). The DBE can be inserted via either the oral or anal approach, and it can reach, on average, about half to two-thirds of the entire small bowel through each route. If the position of the target lesion has been predicted, then the shorter of the two routes can be chosen. It is also possible that the entire small bowel can be observed by the combination of both routes (13, 14). Endoscopic observation and biopsy sampling are quite useful for the diagnosis of small intestine

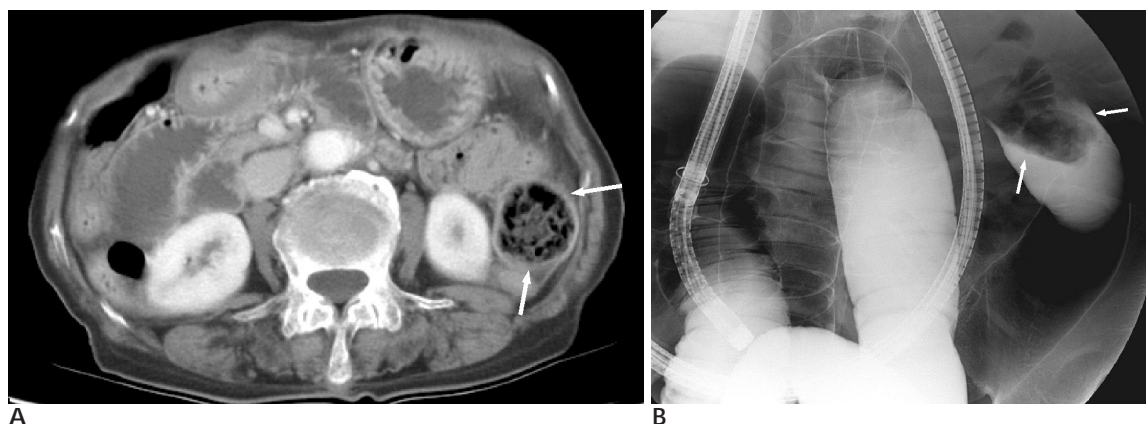


Fig. 1. Small bowel bezoar seen in 83-year-old woman with negative finding at DBE.

A. Transverse CT scan shows a air-bubble contained bezoar (arrows) in small bowel loop.

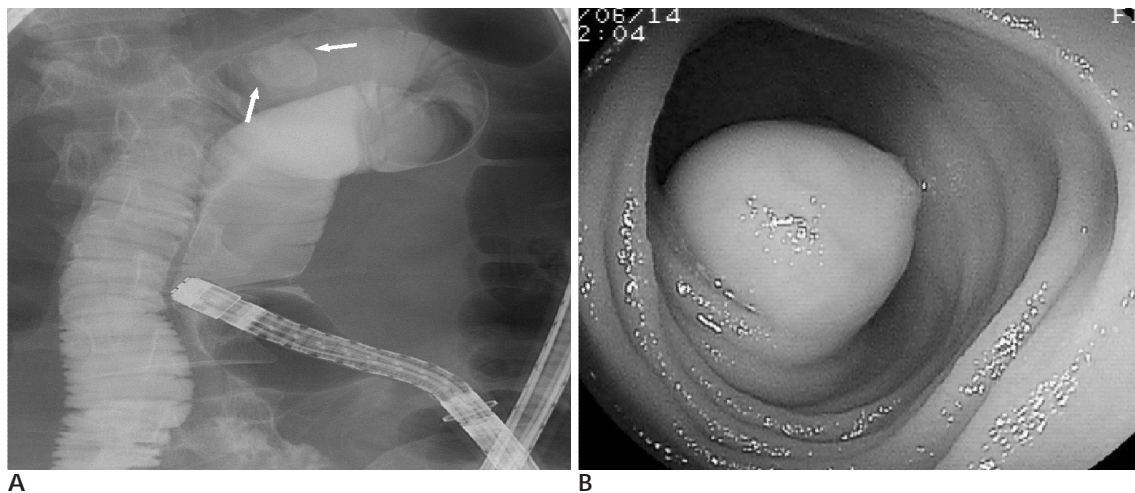
B. ECR image shows round-contoured lesion in small bowel (arrows). ECR was useful in demonstrating the lesion whereas DBE failed to demonstrate since it was unable to reach the lesion

lesions (15, 16). Another advantage of the DBE is that it can be used for endoscopic treatment in the small bowel (12, 13, 17).

During the DBE procedure, ECR can be performed as well by occluding the bowel lumen with balloons to prevent reflux of the contrast media (11). In our experience, ECR can play an important role in the diagnosis and treatment of various small bowel diseases. Especially in case of protrusive lesion, ECR was useful in detecting the location of lesion for planning the surgery (Fig. 2). ECR could reveal the size and shape of diverticular lesions, which can hardly be expected by endoscopic evaluation (Fig. 3). In the cases with severe stenotic lesion in the small bowel, DBE could not pass the lesion and

therefore, it was unable to evaluate the whole extent of the lesion. Under such circumstances, ECR was helpful for evaluating the extent and severity of the stenotic lesion (Fig. 4). Further more, in the cases of inflammatory bowel diseases, ECR is necessary for making comparison with other radiographic imaging techniques such as small bowel follow-through or enteroclysis to determine the effect of treatment (Fig. 4).

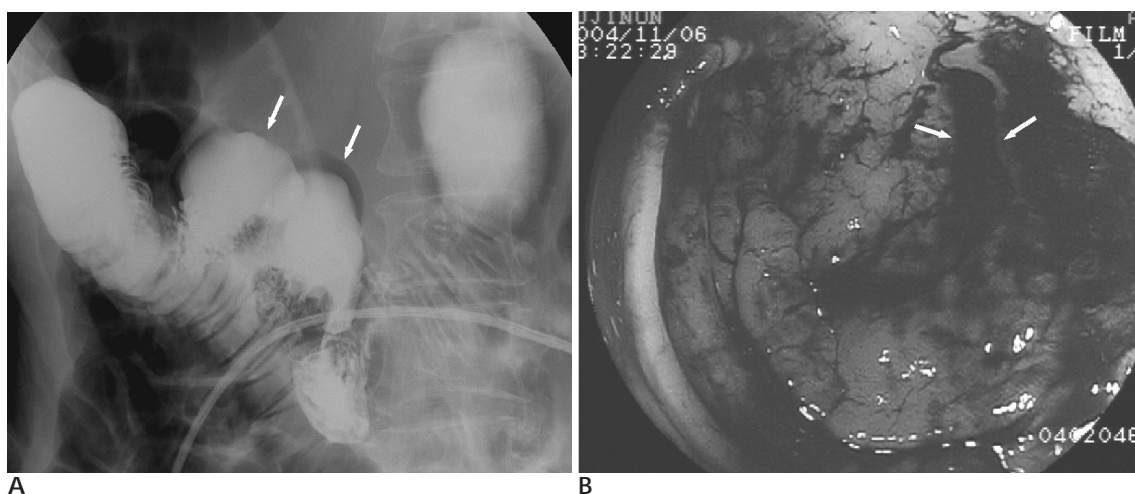
Water-soluble contrast media was used for ECR because of its transparency and watery nature do not interfere with enteroscopic procedures. In case where biopsy is considered, which may cause bowel perforation and leakage of contrast media into the peritoneal cavity, using a water-soluble contrast media is necessary.



**Fig. 2.** Lipoma in 51-year-old woman which was incidentally found during anemia workup.

**A.** ECR image shows a small, round protrusive lesion (arrows) in distal jejunum.

**B.** DBE image reveals a yellowish submucosal tumor



**Fig. 3.** Jejunal diverticuli in 75-year-old man with melena.

**A.** ECR shows two large diverticuli (arrows) in the proximal jejunum.

**B.** DBE reveals a diverticular openings (arrows) covered with blood clots but was unable to demonstrate the size or shape of the lesion.



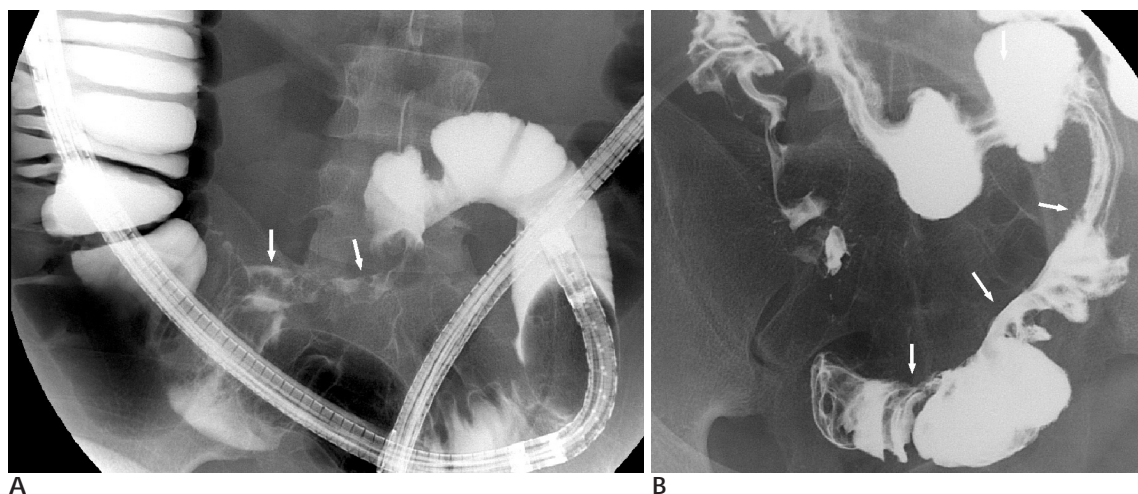


Fig. 4. Images in 26-year-old man with Crohn's diseases.

A. ECR shows stenosis and mucosal changes (arrows) in the distal ileum.

B. SBFT performed 6 months later reveals slightly improved mucosal nodularity and stenosis (arrows).

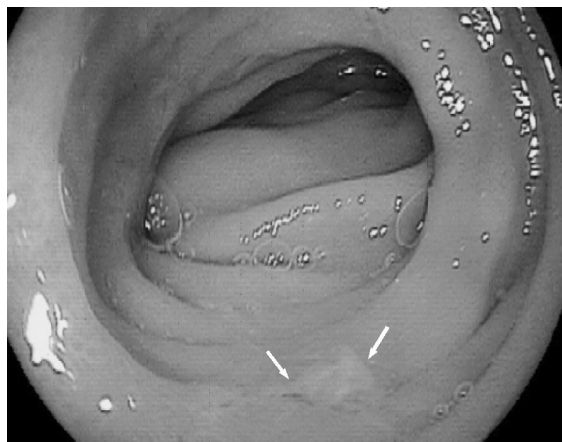


Fig. 5. DBE image in 49-year-old woman with chronic active inflammation shows shallow ulcers (arrows) in the distal jejunum. This ulcer was not depicted at ECR images.

There are several limitations of ECR. ECR examination of all the small bowel loops is an unnecessary and a time-consuming procedure. Therefore, in our study, ECR was only performed for those cases for which DBE revealed small bowel lesions. As a result, the ECR examination was dependant on the DBE finding and the diagnostic accuracy of ECR could not be determined. Furthermore, for the cases with inflammatory bowel disease, ECR was inferior to DBE in detecting small and shallow ulcerations (Fig. 5).

Compared with small bowel follow-through, ECR has disadvantages in evaluating all the small bowel loops. During the DBE procedure, the patient's position is restricted and sometimes small bowel lesions are overlapped by endoscopic equipments on the radiographic

images, which results in some difficulty to get good ECR images.

Our study has several limitations, one of which is that the DBE and ECR findings were not compared. Another limitation is that only a small number of cases were studied. In order to establish the diagnostic value of ECR, further investigations involving a large number of cases are required.

In conclusion, in case of small bowel lesions that require surgical treatment or follow-up study, ECR can be helpful for planning surgery and to determine the effect of treatment.

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