

MINIMALLY INVASIVE EXTRACTION OF A FOREIGN BODY FROM THE SMALL INTESTINE USING DOUBLE-BALLOON ENDOSCOPY

MASANAO NAKAMURA¹, YOSHIKI HIROOKA², OSAMU WATANABE¹, TAKESHI YAMAMURA², ASUKA NAGURA², TORU YOSHIMURA¹, ARIHIRO NAKANO¹, TAKAFUMI ANDO¹, NAOKI OHMIYA³ and HIDEMI GOTO¹

¹*Department of Gastroenterology and Hepatology, Nagoya University Graduate School of Medicine, Nagoya, Japan*

²*Department of Endoscopy, Nagoya University Hospital, Nagoya, Japan*

³*Department of Gastroenterology, Fujita Health University, School of Medicine, Toyoake, Japan*

ABSTRACT

Double-balloon endoscopy (DBE) can be used to treat disorders of the small intestine and can also be used to retrieve foreign bodies from the small intestine without surgery. We describe the findings of 22 cases in which DBE was used to try and retrieve foreign bodies from the small intestine. The foreign bodies included 12 capsule endoscopes, 3 artificial teeth, 3 medical tubes, 2 worms, 1 press-through packet of medicine, and 1 intestinal stone. The retrieval success rate was 86.3% (19/22), and there were no complications related to the retrieval procedures. Snare forceps were the most useful device for grasping the foreign bodies, and DBE was usually performed via an oral route. If an anal route is selected in cases involving stenosis of the small intestine, endoscopic balloon dilation will be necessary to reach the target. In conclusion, DBE is very useful for extracting foreign bodies from the small intestine, and the careful selection of the DBE route and the removal device are important for successfully retrieving foreign bodies.

Key Words: foreign body, double-balloon endoscopy, capsule endoscopy, retention

INTRODUCTION

Foreign bodies, such as coins, artificial teeth, and fish bones sometimes become trapped in the gastrointestinal (GI) tract. Patients who experience such problems usually visit hospital just after swallowing the foreign body or when they develop abdominal symptoms. Until recently, when imaging showed that a foreign body was present in the small intestine, physicians had no choice but to remove it surgically. However, double-balloon endoscopy (DBE) was recently developed and has proved to be a promising procedure for diagnosing disorders of the small intestine, and can also be used to perform endoscopic procedures such as, polypectomy, balloon dilation, and procedures aimed at achieving hemostasis.^{1, 2)} In addition, DBE can be used to retrieve foreign bodies from the small intestine.³⁾ Capsule endoscopes (CE) are also useful tools for exploring the small intestine,^{4, 5)} but the CE retention occurs in 1.5% of cases.⁶⁾ In such cases, DBE is

Received: October 28, 2014; accepted: December 9, 2014

Corresponding author: Masanao Nakamura

Department of Gastroenterology and Hepatology, Nagoya University Graduate School of Medicine, 65 Tsuruma-cho, Showa-ku, Nagoya 466-8550, Japan

Telephone: 81-52-744-2172, Fax: 81-52-744-2180, E-mail: makamura@med.nagoya-u.ac.jp

used both to diagnose stenosis of the small intestine and retrieve the CE.⁷⁾ In the present case report, we aim to evaluate the usefulness of DBE for extracting foreign bodies from the small intestine without surgery.

ANALYSES

Of 1280 consecutive patients with suspected or confirmed disorders of the small intestine who underwent DBE between June 2003 and December 2013, 22 were definitively diagnosed with a foreign body in the small intestine via imaging studies. We attempted to retrieve the foreign bodies using DBE. The DBE insertion route was selected according to the location of the foreign body on the radiological images. In patients with stenosis of the small intestine, an antegrade route was recommended. Endoscopic snare forceps were the device that was most commonly used to retrieve the foreign bodies. The cases of the 22 patients were retrospectively reviewed by examining their medical charts and conducting interviews. The 22 cases involved 12 males and 10 females. The patients' mean age was 57 ± 19 -years-old. The foreign bodies found in the small intestine included 12 CE (Figure 1), 3 artificial teeth, 3 medical tubes (Figure 2), 2 worms, 1 press-through packet of medicine, and 1 intestinal stone. The 12 CE were located in strictures caused by disorders of the small intestine (4 cases of Crohn's disease, 2 cases of non-steroidal anti-inflammatory drug-induced damage, 2 cases of malignant lymphoma, 2 cases involving anastomoses, 1 case of cancer, and 1 case of ischemic enteritis) (Table 1). Thirteen of the foreign bodies were located in the jejunum, and 9 were located in the ileum. An oral route was selected in 14 patients, and an anal route was employed as the initial approach in 8 patients. However, in 6 DBE procedures involving anal routes it was not possible to reach the foreign bodies, and oral procedures were subsequently performed. The overall retrieval success rate was 86.3% (19/22), and there were no complications related to the retrieval procedures. There were 3 foreign bodies that could not be extracted by DBE, including one CE in the ileum, one artificial tooth that had become fixed deep in the ileal wall, and one medical tube that was trapped in a blind loop associated with an anastomosis. The endoscope could not reach the latter CE, which was located in front of a stenotic region due to severe abdominal adhesion and stenosis of the small intestine caused by Crohn's disease, even though attempt were made via both routes. The artificial tooth and the medical tube were reached using DBE, but could not be removed because they were difficult to extract from the small intestinal wall due to severe inflammatory fibrosis in the surrounding regions.



Fig. 1 a, b, c: An 83-year-old female patient. She underwent capsule endoscopy due to severe anemia. The capsule endoscope (CE) remained in the small intestine for an unknown reason. Antegrade DBE was performed to retrieve the CE and elucidate the reason for its retention. The CE was safely grasped and retrieved using snare forceps. It was found that the CE had become trapped due to a stricture caused by a small intestinal anastomosis.

EXTRACTING FOREIGN BODIES USING DBE



Fig. 2 a, b, c: A 29-year-old female patient. She had a drainage tube inserted into her bile duct after bile duct surgery. However, the tube spontaneously migrated into the bile duct. DBE was performed. When the anastomosis produced during the previous choledochojejunostomy was reached, a part of the tube was discovered. The tube was retrieved by pulling it out using forceps.

Table 1 Cases in which DBE was used to try and retrieve foreign bodies (our series)

| Patient's age | Gender | Foreign body | Baseline disease | Location | BAE route | Results | Removal device | Alternative Approach |
|---------------|--------|--------------|-------------------------|----------|-----------|---------|------------------------|----------------------|
| 17 | F | CE | Crohn's disease | Ileum | Anal→Oral | Success | snare forceps | |
| 38 | M | CE | Crohn's disease | Ileum | Anal→Oral | Success | snare forceps | |
| 76 | M | CE | NSAIDs injury | Ileum | Anal→Oral | Success | snare forceps | |
| 67 | M | CE | small bowel anastomosis | Ileum | Anal→Oral | Success | snare forceps | |
| 80 | M | CE | NSAIDs injury | Ileum | Anal→Oral | Success | snare forceps | |
| 64 | F | CE | Malignant lymphoma | Ileum | Oral | Success | snare forceps | |
| 79 | F | CE | Malignant lymphoma | Jejunum | Oral | Success | snare forceps | |
| 55 | M | CE | small bowel cancer | Jejunum | Oral | Success | snare forceps | |
| 33 | M | CE | Crohn's disease | Jejunum | Oral | Success | snare forceps | |
| 73 | F | CE | Ischemic enteritis | Jejunum | Oral | Success | snare forceps | |
| 83 | F | CE | small bowel anastomosis | Jejunum | Oral | Success | snare forceps | |
| 35 | M | CE | Crohn's disease | Ileum | Oral→Anal | failed | | Surgery |
| 78 | F | denture | none | Ileum | Anal | Success | biopsy forceps | |
| 64 | F | denture | none | Jejunum | Anal→Oral | failed | | Surgery |
| 62 | M | denture | none | Jejunum | Oral | Success | biopsy forceps | |
| 58 | M | medical tube | post-biliary surgery | Jejunum | Oral | Success | biopsy forceps | |
| 50 | M | medical tube | post-biliary surgery | Jejunum | Oral | failed | | PTBD |
| 29 | F | medical tube | post-biliary surgery | Jejunum | Oral | Success | biopsy forceps | |
| 25 | F | Worm | Worm | Jejunum | Oral | Success | Gastrografin injection | |
| 61 | M | Worm | Worm | Jejunum | Oral | Success | Gastrografin injection | |
| 74 | F | PTP | none | Ileum | Anal | Success | water injection | |
| 70 | M | stone | small bowel anastomosis | Jejunum | Oral | Success | net forceps | |

CE: capsule endoscopy, PTP: press-through package of medicine, PTBD: percutaneous transhepatic biliary drainage

DISCUSSION

Foreign bodies are rarely encountered in the small intestine, and certain items such as needles⁸⁾ and fish bones⁹⁾ can sometimes be hard to extract and carry a risk of intestinal perforation. Therefore, the optimal method for extracting foreign bodies safely and non-invasively is disputed. However, DBE has recently emerged as a valuable method for retrieving foreign bodies as well as investigating and treating disorders of the small intestine. Using DBE, it is possible to avoid intraoperative endoscopy or open surgery. We reviewed the cases of foreign bodies in

Table 2 Case reports of the foreign body retrieved by balloon assisted endoscopy

| Author | Journal | Year | Patient's age | Gender | Disease | Foreign body | Location | BAE route | Removal device |
|---------------------|-------------------------------|------|---------------|--------|-----------------|------------------------------|----------|-----------|-----------------|
| May A | Endoscopy | 2005 | N/A | N/A | Crohn's disease | capsule endoscope | jejunum | oral | N/A |
| Tanaka S | J Gastroenterol Hepatol | 2006 | 33 | M | Crohn's disease | capsule endoscope | jejunum | oral | net forceps |
| Miehlke S | Endoscopy | 2007 | 43 | M | Crohn's disease | capsule endoscopes | ileum | anal | snare forceps |
| Chu Y. C | Endoscopy | 2007 | 67 | M | anastomosis | migrated biliary metal stent | jejunum | oral | N/A |
| Orlent H | Gastrointest Endosc. | 2008 | 66 | F | anastomosis | migrated metal stent | jejunum | oral | biopsy forceps |
| Shibuya T | Med Sci Monit. | 2008 | 33 | M | none | eel bone | jejunum | oral | biopsy forceps |
| Neumann H | Digestive Disease | 2009 | 45 | F | none | coin | ileum | oral | snare forceps |
| Zuber-Jerger I | Eur J Gastroenterol Hepatol | 2009 | 18 | M | Crohn's disease | capsule endoscope | ileum | N/A | N/A |
| Safetle-Ribeiro A.V | Gastrointest Endosc. | 2009 | 12 | F | none | sewing needle | jejunum | oral | biopsy forceps |
| Chou J. W | Clinical Gastrointest Hepatol | 2009 | 68 | F | none | phyto bezoar | jejunum | oral | basket catheter |
| Hsieh M.J | Endoscopy | 2011 | 43 | M | none | toothpick | jejunum | oral | snare forceps |
| Monkemuller K | Gastrointest Endosc. | 2011 | 51 | M | none | root canal needle | jejunum | oral | basket catheter |
| Fry L.C | Endoscopy | 2012 | 48 | M | none | denture | jejunum | oral | snare forceps |
| Yuki T | Digestive Endoscopy | 2012 | 70 | M | none | fish bone | ileum | anal | snare forceps |
| Alkhatib A.A | Gastrointest Endosc. | 2013 | 67 | M | none | fish bone | jejunum | oral | snare forceps |

BAE: balloon assisted endoscopy

the small intestine that we have experienced and cases from the literature in which balloon-assisted endoscopy was employed to evaluate how foreign bodies in the small intestine should be extracted using DBE. DBE resulted in a retrieval success rate of 86% in our series. In the literature, most of the foreign bodies that were successfully extracted from the small intestine using balloon-assisted endoscopy were located in the jejunum, and the oral route exhibited the highest success rate (Table 2).

Foreign bodies can become trapped in the small intestine via two mechanisms. In cases in which the small intestine contains a severe stricture, foreign bodies will not be able to pass through unless they get broken down before they reach the stricture. Providing that it is possible to reach the foreign body with DBE, it will be easy to extract. If the intestine contains multiple strictures, as is found in Crohn's disease, and the foreign body is trapped between two strictures, it will be difficult and risky to extract the object. On the other hand, needle-like and hook-like objects can become trapped in the small intestine, even in the absence of strictures. Such items can cause inflammation and fibrosis in the surrounding region and can be difficult to remove from the intestinal wall. It is possible to dissect the surrounding mucosa using a needle knife, but this technique is not established and carries a risk of intestinal perforation.

It is very important to select the DBE insertion route and the removal device carefully to improve the likelihood of the foreign body being successfully extracted. When DBE is used to explore the small intestine, the route is generally selected based on the findings of CE and localization software.¹⁰⁾ However, CE can not be used for extracting foreign bodies from the small intestine because patients suffering from such problems often also exhibit small intestinal strictures. So, other imaging techniques; e.g., CT scans or small intestine follow through examinations, are employed. In cases involving small intestinal strictures, an oral route is preferable, even if the foreign body is located in the ileum; however, it will take a long time to reach the target. On the other hand, performing DBE via an anal route is more complicated because it would be necessary to subject the stricture to endoscopic balloon dilation to reach the foreign body.¹¹⁾ Therefore, performing DBE via an anal route is only of use for extracting foreign bodies in the lower ileum or foreign bodies in the upper ileum in patients without small intestinal stenosis. In addition, bowel preparation is necessary prior to performing DBE via an anal approach, even

in cases involving small intestine strictures.

It should be harder to extract foreign bodies from the small intestine than from the stomach because the lumen is narrow, and the foreign body will always be located a long way from the mouth or anus. What kind of devices should be used to grasp objects in the narrow lumen of the small intestine? Snare forceps were the most frequently used device in our series as well as in the literature and are able to grasp foreign bodies tightly and are attached to relatively hard lines of variable length. Net or basket catheters can sometimes be used, but will not work in cases in which there is not enough space to open them fully. Biopsy forceps are also useful, especially for objects with sharp points and objects containing soft tissue. However, they can not be used to extract spherical or large objects.

The complications associated with this DBE include intestinal perforation, GI bleeding, and intestinal infection. It is easy to damage the intestinal mucosa during the extraction of foreign bodies. In cases in which the foreign body might cause damage to the intestine, it would be safer to pull the object out through a flexible external tube. In the case of large objects, it might be better to pull them out just behind an external flexible tube because the width of the flexible tube would aid the smooth passage of the foreign body. The choice of DBE route, the device employed, and the use of a gentle and careful technique are important for successfully retrieving foreign bodies.

In conclusion, DBE is very useful for removing foreign bodies located in the small intestine.

ACKNOWLEDGMENTS

Part of the study was supported by JSPS KAKENHI Grant Number 25461032 and the Japanese Foundation for Research and Promotion of Endoscopy.

CONFLICTS OF INTEREST

None of the authors have any financial relationships that are relevant to this publication to disclose.

REFERENCES

- 1) Yamamoto H, Kita H, Sunada K, Hayashi Y, Sato H, Yano T, Iwamoto M, Sekine Y, Miyata T, Kuno A, Ajibe H, Ido K, Sugano K. Clinical outcomes of double-balloon endoscopy for the diagnosis and treatment of small-intestinal diseases. *Clin Gastroenterol Hepatol*, 2004; 2: 1010–1016.
- 2) Yano T, Yamamoto H. Current state of double balloon endoscopy: the latest approach to small intestinal diseases. *J Gastroenterol Hepatol*, 2009; 24: 185–192.
- 3) Van Weyenberg SJ, Van Turenhout ST, Bouma G, Van Waesberghe JH, Van der Peet DL, Mulder CJ, Jacobs MA. Double-balloon endoscopy as the primary method for small-bowel video capsule endoscope retrieval. *Gastrointest Endosc*, 2010; 71: 535–541.
- 4) Nakamura M, Niwa Y, Ohmiya N, Miyahara R, Ohashi A, Itoh A, Hirooka Y, Goto H. Preliminary comparison of capsule endoscopy and double-balloon enteroscopy in patients with suspected small bowel bleeding. *Endoscopy*, 2006; 38: 59–66.
- 5) Nakamura M, Hirooka Y, Watanabe O, Yamamura T, Furukawa K, Funasaka K, Ohno K, Miyahara R, Kawashima H, Ando T, Ohmiya N, Goto H. Three Cases with Active Bleeding from Radiation Enteritis that were Diagnosed by Video Capsule Endoscopy without Retention. *Nagoya J Med. Sci*, 2014; 76: 369–374.
- 6) Cave D, Legnani P, de Franchis R, Lewsi BS. ICCE consensus for capsule retention. *Endoscopy*, 2005; 37: 1065–1067.

- 7) Tanaka S, Mitsui K, Shirakawa K, Tatsuguchi A, Nakamura T, Hayashi Y, Sakamoto C, Terano A. Successful retrieval of video capsule endoscopy retained at ileal stenosis of Crohn's disease using double-balloon endoscopy. *J Gastroenterol Hepatol*, 2006; 21: 922–923.
- 8) Mönkemüller K, Zabielski M, Poppen D, Fry LC. Endoscopic removal of an impacted root canal needle in the jejunum using double-balloon enteroscopy. *Gastrointest Endosc*, 2011; 73: 844–846.
- 9) Yuki T, Ishihara S, Okada M, Kusunoki R, Moriyama I, Amano Y, Kinoshita Y. Double-balloon endoscopy for treatment of small bowel penetration by fish bone. *Dig Endosc*, 2012; 24: 281.
- 10) Nakamura M, Ohmiya N, Shirai O, Takenaka H, Morishima K, Miyahara R, Ando T, Watanabe O, Kawashima H, Itoh A, Hirooka Y, Goto H. Route selection for double-balloon endoscopy, based on capsule transit time, in obscure gastrointestinal bleeding. *J Gastroenterol*, 2010; 45: 592–599.
- 11) Ohmiya N, Arakawa D, Nakamura M, Honda W, Shirai O, Taguchi A, Itoh A, Hirooka Y, Niwa Y, Maeda O, Ando T, Goto H. Small-bowel obstruction: diagnostic comparison between double-balloon endoscopy and fluoroscopic enteroclysis, and the outcome of enteroscopic treatment. *Gastrointest Endosc*, 2009; 69: 84–93.