

# ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

Section Editor: John Baillie, MB ChB, FRCP

## Double-Balloon Enteroscopy in Patients With Altered Biliary and/or Pancreatic Anatomy

Gregory B. Haber, MD  
Director, Division of Gastroenterology  
Lenox Hill Hospital, New York

**G&H** When is double-balloon enteroscopy indicated for use in patients with altered anatomy?

**GH** When faced with the challenge of traversing lengths of bowel to reach the major papilla or an anastomosis of the bile or pancreatic duct, double-balloon enteroscopy is often utilized, as conventional instruments are unable to achieve this goal successfully. The use of double-balloon enteroscopy in patients with altered anatomy for biliary and/or pancreatic access is a niche and uncommon indication. However, recently there has been a significant increase in the performance of bariatric surgery with gastrojejunal bypass, duodenal switches, and other operations in which normal anatomy is altered. In these patients, endoscopists often must reach the biliary or pancreatic duct through a jejunal limb. In the last decade, endoscopists have seen many patients with gastrojejunal bypass, in whom the enteroscope must be advanced along a long limb of jejunum down to a Roux-en-Y anastomosis and then advanced up the afferent jejunal limb past the ligament of Treitz to the duodenum prior to cannulation.

Another indication is resection of the lower end of the bile duct or a Whipple resection, in which, once again, a Roux limb is followed to reach the hepaticojejunal anastomosis. This indication is also not very common, but when it occurs, there are few options other than double-balloon enteroscopy.

One other novel use of double-balloon enteroscopy is retrieval of retained capsules in the small bowel. I have had at least 10 patients referred for capsule retrieval with capsules in their small bowel for up to 2 years who did not have clinical obstruction but had strictures in the small bowel. In these cases, 8 of the 10 capsules

were endoscopically retrieved. As this is not well recognized, many patients are still referred to surgery for capsule retrieval.

**G&H** Could you briefly outline how double-balloon enteroscopy is performed in this patient population?

**GH** In these patients, the double-balloon enteroscopic system, which currently has only a forward-viewing lens and no elevator, is advanced down through the esophagus, the gastric remnant, and then the jejunal limb to the Roux-en-Y anastomosis. At this point, the enteroscope is turned nearly 180° to re-ascend the Roux limb to reach the ligament of Treitz. The enteroscope is then advanced to the papilla. Usually, the overtube can reach down to at least the Roux limb and, frequently, depending upon the angulation of the anastomosis, the overtube can ascend the jejunal limb up toward the ligament of Treitz. Once the enteroscope reaches the papilla, the procedure becomes quite challenging due to the lack of an elevator or side-viewing lens, making it necessary to cannulate the bile or pancreatic duct in the opposite direction. In particularly difficult cases, such as those with a minor papilla or a papilla in a diverticulum, it may be necessary to retroflex the enteroscope in the duodenal cap while descending back toward the papilla. The most difficult parts of double-balloon enteroscopy are traversing the Roux anastomosis to reach the papilla or hepaticojejunal anastomosis and the cannulation of the bile or pancreatic duct with an intact papilla.

**G&H** Is it possible to visualize the entire small bowel using double-balloon enteroscopy?

**GH** In most cases, it is not possible to traverse the entire small bowel from the oral approach with double-balloon enteroscopy, although I have been able to do so in 4 patients with normal anatomy. The median length traversed with the oral approach is approximately two thirds of the length of the small bowel. To visualize the entire

small bowel and achieve a true panendoscopy, endoscopists should perform double-balloon enteroscopy from the oral approach as well as from the anal approach. After performing double-balloon enteroscopy from one direction, india ink is injected submucosally to leave a permanent tattoo and a landmark to be reached when double-balloon enteroscopy is performed from the other direction, thus confirming successful small-bowel panendoscopy.

The anal approach is quite effective for the detection of lesions deep within the small bowel and is the initial approach when the lesion is noted to be at a location greater than 75% of the timeline of the capsule study. In my experience of having performed more than 100 double-balloon enteroscopies from the anal approach, the success rate is greater than 90% for reaching the intended location within the small bowel.

#### **G&H** Could you expand on the success rates of double-balloon enteroscopy from the oral approach?

**GH** The most valuable measure of the utility of double-balloon enteroscopy is its success in reaching the intended anatomic structure as well as its success in facilitating the intended diagnostic or therapeutic procedure. There have been limited numbers of case series and reports using different types of instruments. Prior to the use of this procedure, endoscopists attempted to utilize colonoscopes or push enteroscopes with different types of overtubes. The success rate of these devices was at best 50%. The only remaining option was often operative endoscopy with enterotomy via laparotomy or, more rarely, laparoscopy. In contrast, the success rate of double-balloon enteroscopy has been 80% or more, showing a clear advantage to this procedure. Comparative trials have not been conducted due to the limited number of cases and the limited success of standard endoscopes.

#### **G&H** What are the other advantages of double-balloon enteroscopy compared to standard procedures?

**GH** The major advantage of double-balloon enteroscopy is maneuverability. The double-balloon enteroscope is a smaller caliber instrument than, for example, the colonoscope, and thus has a shorter radius of curvature as well as easier and greater maneuverability at the papilla. It is almost impossible, for instance, to retroflex the colonoscope in the duodenal cap, but it is possible to do this maneuver, which is occasionally needed for successful cannulation, with the double-balloon enteroscope. The channel size of the therapeutic double-balloon enteroscope is 2.8 mm, allowing for the passage of most accessories. Another advantage of the double-balloon system is the ability to move back and forward by keeping the overtube in place, removing

the enteroscope, and then returning back through the overtube to the desired location.

#### **G&H** Has cost-effectiveness analysis been performed to compare double-balloon enteroscopy with other procedures?

**GH** There has not been any formal cost-effectiveness analysis of the use of double-balloon enteroscopy in patients with altered anatomy. Prior to the introduction of this technology, the standard practice was to use operative endoscopy, in which a laparoscopy or laparotomy was performed with an enterotomy and the endoscope was subsequently placed into the jejunum surgically. The endoscope was then moved up and down to visualize the entire small bowel. Clearly, there is a major cost benefit if diagnostic or therapeutic success can be achieved without surgery. Thus, based upon the only other available option, surgery, I think that the enteroscopic approach is clearly much more cost-effective. The only disposable cost of double-balloon enteroscopy is the overtube and the balloons, which are placed on the enteroscope. In addition, the amortization of the capital cost is reasonable, given the hundreds of potential uses of the instruments.

#### **G&H** Are there any risks or complications associated with the use of double-balloon enteroscopy in patients with altered anatomy that are not associated with patients with unaltered anatomy?

**GH** The main complication of double-balloon enteroscopy is perforation, particularly because patients with altered anatomy have had surgery, which results in adhesions, angulations, and atypical turns of small-bowel loops. There is a potential risk of perforation when attempting to negotiate a particularly sharp angulation. Perforation tends to occur more frequently with larger instruments, which are more rigid. In studies with duodenoscopes or colonoscopies for patients undergoing endoscopic retrograde cholangiopancreatography (ERCP) procedures, the reported rate of perforations is approximately 2–3% in patients with Billroth II anatomy. To date, this degree of perforation has not been evident with double-balloon enteroscopy due to the softness and flexibility of the system. Nevertheless, perforation remains a potential concern.

Other risks of double-balloon enteroscopy involve those related to the therapy administered at the papilla or anastomotic structure, such as in a hepatico- or choledocho-jejunostomy. Possible complications include those related to needle-knife sphincterotomy or balloon dilation, though these risks fall within the acceptable rates for these procedures.

## G&H Could you discuss the learning curve and training involved with performing double-balloon enteroscopy in this patient population?

**GH** Double-balloon enteroscopy does require a major commitment of time and is not a quick or easy procedure. However, the learning curve for double-balloon enteroscopy is relatively short. The incremental skills required to perform this procedure are few compared to standard endoscopy. After 20–25 cases, I think that most endoscopists would feel comfortable performing the procedure. The ability to advance further into the bowel may require an additional 25 procedures, but the ability to initiate this procedure in an endoscopy unit does not require a long time in terms of the learning curve. Animal models of ex vivo porcine small bowel are available. Ex vivo experience, familiarity with the technology and technique, and direct observation on several cases should be sufficient for an endoscopist to initiate the procedure.

## G&H Does capsule endoscopy play a role in the use of double-balloon enteroscopy?

**GH** There has been some debate as to whether capsule endoscopy should always be performed prior to double-balloon enteroscopy for suspected small-bowel disease. I consider these procedures to be complementary studies in the evaluation of small-bowel disease. Capsule endoscopy has been very helpful in identifying the level at which pathology may be found. Currently, if the capsule finding falls within 75% of the timeline of small-bowel transit, the lesion is approached by performing double-balloon enteroscopy from the oral approach, whereas if the capsule finding falls within the last 25% of the timeline of small-bowel passage, double-balloon enteroscopy would be performed from the anal approach to search for the pathology. Thus, the capsule provides guidance when determining which route to utilize in the initial approach to the small bowel.

Although capsule endoscopy has been shown to be helpful and appropriate to utilize prior to double-balloon enteroscopy, it should be noted that there is a possibility, though quite small, that pathology may be detected on double-balloon enteroscopy that was not evident on capsule endoscopy. Because of this false-negative rate, a negative capsule finding should not negate the value of a double-balloon study. In my practice, we have identified tumors that have not been detected on capsule endoscopy.

## G&H Are there other related technologies or endoscopic devices currently in development?

**GH** There are other technologies, such as single-balloon enteroscopy and the Spirus Endo-Ease device, currently in development to further improve small-bowel access.

Although these technologies appear to be quite promising, there has been very limited experience with them to date. The clinical experience thus far certainly suggests that these alternate technologies are effective for achieving small-bowel intubation up to, approximately, the level of the midjejunum, but are limited in terms of insertion depth. Moreover, slow withdrawal for careful inspection of the bowel may be more challenging with these other technologies. In the future, there may be a menu of available enteroscopic devices, some of which may be less expensive or faster, but with a more limited ability to intubate the length of the small bowel.

## G&H What do you foresee as the next steps for future research in this area?

**GH** One of the biggest challenges in this area involves the obscure gastrointestinal bleed. In spite of the ability to traverse nearly all or, on occasion, the entire small bowel, it can be difficult to identify a small bleeding lesion. Additional provocative tests could be considered to induce bleeding, similar to those used in angiography, in which patients were placed on heparin to detect the bleeding site and markers released via capsule endoscopy, automatic tattooing, or stain when active bleeding was encountered. We still have not developed a successful method for detection of obscure bleeds in patients taking antiplatelet agents or anticoagulants.

Another question that requires further research is whether the anaesthetic used with double-balloon enteroscopy may decrease blood pressure, perfusion of the vessel, and identification of the culprit vessels.

The instruments used with the double-balloon system would benefit from larger channel sizes for easier passage of therapeutic devices, particularly with ERCP. Devices used for cannulation or treatment of pancreatic or biliary anastomoses require a fuller range of adequate lengths and, perhaps, the development of a specialized instrument with an oblique lens and an elevator to facilitate cannulation and therapy.

## Suggested Reading

Haber GB. Double-balloon enteroscopy for pancreatic and biliary access in altered anatomy (with videos). *Gastrointest Endosc.* 2007;66(3 suppl):S47-S50.

Aabakken L, Bretthauer M, Line PD. Double-balloon enteroscopy for endoscopic retrograde cholangiography in patients with a Roux-en-Y anastomosis. *Endoscopy.* 2007;39:1068-1071.

Ross A, Mehdizadeh S, Tokar J, Leighton JA, Kamal A, et al. Double balloon enteroscopy detects small bowel mass lesions missed by capsule endoscopy. *Dig Dis Sci.* 2008 Feb 13 [E-pub ahead of print].

Mönkemüller K, Fry LC, Bellutti M, Neumann H, Malfertheiner P. ERCP using single-balloon instead of double-balloon enteroscopy in patients with Roux-en-Y anastomosis. *Endoscopy.* 2008 Feb 18 [E-pub ahead of print].

Maaser C, Lenze F, Bokemeyer M, Ullerich H, Domagk D, et al. Double balloon enteroscopy: a useful tool for diagnostic and therapeutic procedures in the pancreaticobiliary system. *Am J Gastroenterol.* 2008;103:894-900.