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# New Developments in Endoscopy

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## Abstract

The small bowel remains the “last frontier” in gastroenterology for a long period after the start of endoscopy. Even with the advent of better endoscopes and colonoscopies barium meal and follow through remained the preferred method of investigation of the small bowel. Although push enteroscopy was present from the 1980’s it was not until the advent of device assisted enteroscopy that the small bowel was finally conquered. Device assisted enteroscopy includes, double balloon enteroscopy, single balloon enteroscopy and spiral enteroscopy. The other method of visualizing the small bowel was capsule enteroscopy. Capsule enteroscopy too revolutionized endoscopy as it gave patients a degree for freedom never before enjoyed and would be the best screening tool available. However, its main disadvantage remains the inability to obtain biopsies.

**Keywords:** Enteroscopy, small bowel, double ballon, single balloon, spiral enteroscopy, capsule enteroscopy

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## 1. Introduction

### 1.1. Imaging the small bowel – The last frontier

The small bowel has remained the “last frontier” in gastroenterology for a long period after the start of endoscopy. Even with the advent of better endoscopes and colonoscopies. Barium meal and follow through remained the preferred method of investigation of the small intestine for many years [1]. This however, was inconvenient, exposed the patient to unwanted radiation and provided poor quality pictures. In a way it was similar to the back and white television of

old. Other methods include computed tomography (CT) enteroclysis or enterography, magnetic resonance enteroclysis or enterography and small bowel ultrasound.

One reason for this delay in finding a proper modality for imaging the small intestine maybe the fact that small intestinal tumours are much less common than colonic polyps[2]. Thus the need for the procedure may not have been as urgent as it was for say colonic investigation. However, during the last ten years this “last frontier” has been well and truly conquered. Balloon enteroscopy, and capsule endoscopy have revolutionized the investigation of small bowel disorders. In this chapter we will discuss the various methods and their advantages and disadvantages. Although push enteroscopy has been around since the 80’s the real break through was after the onset of device assisted enteroscopy.

## 2. Enteroscopy

Enteroscopy is the act of passing an endoscope beyond the second part of the duodenum and examining the small intestine. It can be divided into push enteroscopy(PE) and device assisted enteroscopy (DAE). Although push enteroscopy has been around since the 1980’s this did not allow the full visualization of the small bowel and was very difficult for the patient. This was mainly due to excessive looping of the scope in the small intestine. The length of a PE ranges from about 220 cm to 250 cm and is inserted per orally [3]. This was used occasionally, mainly to try to visualize occult bleeding from the gastrointestinal tract. Enteroscopy was revolutionized by the discovery of DAE the first of which was double balloon enteroscopy (DBE) which, allowed full visualization of the entire small intestine [4]. Subsequently more methods of enteroscopy have been introduced. These are single balloon enteroscopy (SBE) and spiral enteroscopy(SE). With the use of DAE not only has complete visualization of the small intestine been possible, various therapeutic procedures like polypectomy, dilatation or treatment of bleeding hitherto possible only with surgery or laparoscopy could also be performed. This was truly a revolution in gastroenterology.

## 3. DAE

### 3.1. Double Balloon (DUB)

Double balloon was first developed in 2001 by Professor Hironori Yammamoto [5]. The system has an endoscope of with an outer diameter of 8.5 mm and a working length of 200cm. It has a soft over tube of 145cm with a 12.2 mm outer diameter and a separate pump. Air insufflation or carbon dioxide is used. Carbon dioxide is recommended as it results in less distension post procedure.

Preparation for the procedure is the same as for a regular colonoscopy. Which will include overnight fasting for solids and the consumption of 4 liters of polyethylene glycol preparation. This is usually consumed in as a split preparation. That is two liters consumed the previous night and the other two liters consumed the next morning.

One balloon is attached to the tip of the scope and the other to the end of the scope [6]. The procedure can be done in an anterograde (oral) or retrograde (anal) method. The endoscope and the over tube is first advanced as far as possible, then the balloon on the over tube is inflated to fix the over tube. Then the endoscope is further advanced as far as possible. Next the balloon on the over tube is deflated and the over tube is advanced up to the inflated tip of the endoscope. The balloon on the over tube is also inflated. Then both endoscope and over tube are with drawn thus, pleating the small intestine. This maneuver is repeated till the scope cannot be advanced any further. At this point the intestine is tattooed using India ink. Then the procedure is repeated in a retrograde manor. The ileum is crossed as would be done during a normal colonoscopy. Thus complete visualization of the small bowel is achieved.

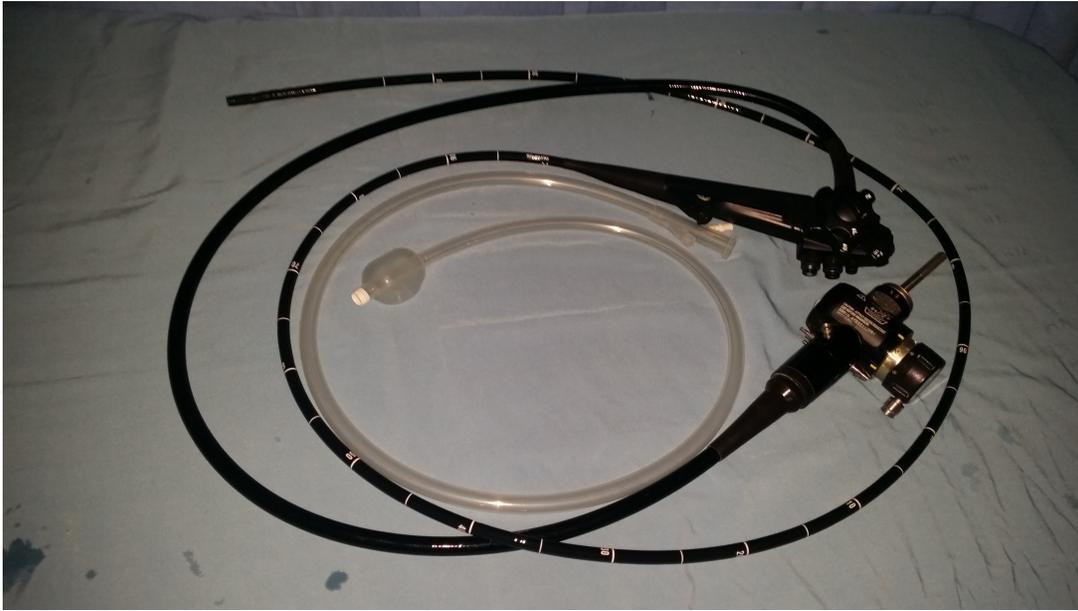
This procedure could take from 70 minutes to 120 minutes. According to guidelines the patient should receive propofol anesthesia [7]. Fluoroscopy is useful during the learning phase but is not essential. During the learning curve two operators are used. However, later a single operator should suffice. Using the therapeutic channel of the enteroscope most therapeutic procedures that can be performed with a normal upper gastro intestinal endoscope can be done using the enteroscope. This makes it a very useful tool. Although this is relatively safe procedure the complication do occur and will obviously depend on the experience of the operator. The perforation rate is about 0.4 % which can increase to 3% if dilatation is attempted. Other complications include pancreatitis (0.3%), this can be reduced if the balloon is inflated after passing the papilla [8].

### **3.2. Single balloon enteroscopy(SBE)**

Single balloon enteroscopy was introduced in 2007. It uses an enteroscope with a 200cm working length and 2.8 mm channel diameter. The over tube has a diameter of 13.2 and a silicon balloon with a separate pump(figure 1). The technique is the same as for DBE. However, the tip of the balloon is used to anchor the enteroscope to the intestine. Thus there is only one balloon. This makes SBE faster than DBE, Generally it can be used with one operator. As for other types of enteroscopy anesthesia with propofol is the preferred type of anesthesia. Like in DBE both the anterograde and retrograde approaches are used depending on the requirement. Therapeutic procedure are similar with using the SBE. In addition to the speed and simplicity of the procedure the other advantages of the SBE are the fact that is has variable stiffness. Thus eliminating the need for a stiffing wire. It also can be used on patients who have latex allergy. However, it has a lower rate of complete enteroscopy when compared to DBE in most studies.

### **3.3. Spiral Enteroscopy (SE)**

Spiral enteroscopy was introduced in 2008. It has a 118 cm Endo-EaseDiscovery™ SB overtube with a internal diameter of 9.8mm with a softraised helix, a coupling device to fix to the lubricated overtube to theenteroscope 25 cm from its tip. It has two handles for manual rotation andan injection port for lubrication [9]. Clock wise rotation pleats the smallintestine into the scope, once engaged and advances the same thustransforming the torching force into a linear force. The push and rotatetechnique is used till it passes the ligament of Trietz. After that



**Figure 1.** SBE with sheath

rotation is only used. The mesentery of the small bowel prevents it from getting twisted. Like in both DBE and SBE propofol anesthesia is recommended. Two operators are used for the procedure. One to operate the overtube and the other to use the scope. Withdrawal is by anti clockwise rotation. The mean time for the procedure is about 34 minutes [10]. The major advantages of SE is the speed of insertion and the fact that it doesn't need extra equipment like a pump. Also the overtube can be disengaged from the coupler enabling the enteroscope to be withdrawn without losing the position in the small intestine. This is particularly useful in removing multiple polyps. The overall complication rate is about 0.3% with a perforation rate of 0.4%. The rate of pancreatitis seems lower than in DBE and SBE. So SE seems a useful tool to examine the small bowel as well.

#### 4. Video Capsule Endoscopy (VCE)

The invention of the capsule endoscopy system about 15 years ago once again changed the imaging of the small bowel for ever, giving clear imaging for the first time. Not only is less invasive than endoscopy it gave pictures similar in quality as well. Capsule endoscopy system consists of the wire less capsule which has video camera a sensing system (this includes sensing belt, a data recorder unit, a battery pack and a real time viewer) and a personal computer work station (figure 2). The work station is equipped with manufacturer's software that offers various functions (localization system, colour enhancement systems, blood detector, quick viewer, scoring system, image atlas) this can help the examiner in reviewing and interpreting the images [11]. There are various VCE systems. The capsules themselves and the picture quality has been advancing rapidly.



**Figure 2.** Video capsule recording system

One of the main contraindications for VCE would be suspected intestinal obstruction, strictures, fistulas and as this may result in capsule retention.

The incidence of capsule retention is about 1.4% [12]. VCE is also generally not performed with patients with cardiac pacemakers due to the possibility of interference with these devices. Pregnancy is another contraindication due to the lack of safety data.

Preparation before endoscopy, overnight fast for solids and the consumption of clear liquids only coupled with two liters of poly ethylene glycol (PEG). Although the use of PEG is not compulsory, the consensus is to use it. Generally about 80% of the patients have a complete examination of their small bowel.

Common indications for VCE include, obscure gastrointestinal (GI) bleeding, Crohn's disease, coeliac disease and suspected small intestinal polyps. Of these indications the most commonly used indication would be occult GI bleeding.

One of the biggest disadvantages of the capsule is that currently there is no possibility of taking biopsies or applying any therapeutic procedure to the small intestine. Currently there are some capsules have some degree of maneuverability. Also there is a capsule that does not need the patient to wear any external devices at all. However, this capsule needs to be retrieved to access the data. Future VCE should be able to overcome the disadvantage of inability to take biopsies as currently research and development of a capsule with therapeutic capabilities are underway [13].

## 5. Conclusion

Due to the patient friendly nature of the examination ideally capsule endoscopy is used in tandem with balloon enteroscopy. This is because currently one of the main disadvantage of

VCE is the lack of the ability to take biopies and to deliver therapy. Also the VCE can give an indication of whether to start the DAE in an anterograde or retrograde direction. When comparing DBE, SBE and SE all are similar although SBE and SE are more simple DBE results in more complete examination of the small intestine.

Device assisted enteroscopy and capsule endoscopy when used in tandem can provide the gastroenterologist with a previously unimaginable access to the small bowel. To the patient it provides hope and comfort that was never before available. Gastroenterologist all over eagerly await the development of maneuverable VCE with therapeutic options. Thus the "last frontier" of gastroenterology the small intestine has been well and truly conquered.

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