Introduction
Exploratory surgery is often considered in the patient with recurrent, obscure GI bleeding. Unfortunately, unless the bleeding site is a palpable lesion, such as a small bowel tumor or a Meckel's diverticulum, the bleeding site may go unidentified.

Though a number of methods have been used, intraoperative endoscopy (IOE) is presently the most widely used method for identifying small intestinal sites of bleeding. With yields between 83-100% reported, IOE is extremely successful in identifying the site of blood loss. Long-term follow-up of patients after IOE shows a rate of re-bleeding between 0-45%.

Despite this high success rate, IOE is quite difficult to perform and carries significant risks. Using oral placement of a colonoscope, it is possible to reach the ileocecal valve in only 60% of cases, and only as far as the distal ileum (within two feet of the valve) in another 15%. IOE is also quite traumatic to the bowel. Mucosal lacerations occur in 50% of cases, and perforations occur in 5%. Prolonged ileus has been encountered after IOE with return of bowel function taking up to 11 days post-operatively.

In an effort to minimize risk, it has long been recommended that a non-crushing clamp be placed across the terminal ileum prior to the start of instrument advancement into the small bowel. This step prevents distention of the colon with insufflated air from the endoscope that would track down the small bowel and enter the large bowel. Once air inflates the colon, it cannot be evacuated readily, since the instrument is frequently not passed into the colon. Air quickly fills both the left and right colon. Massive air distention can mean that the surgeon must stretch the abdominal wall to close the incision. This may lead to wound dehiscence and infection in the post-operative period. In addition, small bowel distention with endoscopically insufflated air can hamper the exam since it is difficult to pleat the small bowel onto the shaft of the endoscope. Small bowel distention can also lead to perforation or even ischemia with compression of supplying blood vessels.

Use of carbon dioxide (CO₂) during IOE is intuitively appealing. Studies have shown that CO₂ absorption by the bowel's circulation is much faster than the absorption of air. Use of CO₂ during IOE was thus postulated to improve this exam's performance.

Patient History
The patient was a 39-year-old woman with a long history of obscure gastrointestinal bleeding. Colonoscopy and upper endoscopy had been normal in the past. A prior capsule endoscopy had revealed varices of the distal small bowel. The remainder of the small bowel was normal and no other abnormalities were seen. Mesenteric angiography was subsequently performed which confirmed the presence of small and isolated ileal varices. A diagnosis of congenital varices was made and surgical resection was scheduled.

Diagnostic Goal
The relatively unfixed, convoluted state and length of the small intestine make it difficult to correlate findings on preoperative studies with a specific loop of the intestine at laparotomy. The patient was referred for intraoperative endoscopy to help identify the location of the varices to help avoid wide resection at surgery.
Exam Procedure

IOE with Carbon Dioxide Endoscopic Insufflator: In the operating room, the abdomen was initially explored laparoscopically. The distal ileum was exteriorized through a small McBurney’s incision. An enterotomy was created and an enteroscope was placed in a sterile plastic sheath and passed through it into the ileum. With surgical assistance, the enteroscope was advanced proximally to the jejunum and distally to the ileocecal valve. No clamp was used and only CO₂ was insufflated into the bowel using the CO₂ EFFICIENT® endoscopic insufflator. Following the resection, the bowel was placed back into the abdomen and the wound was closed.

Findings

The area of varices was identified and it was elected to perform an ileocolic resection.

With the bowel distended by gas, the surgeon measured the bowel wall circumference (Figure 1). At maximum distension the circumference measured 10 cm. After 10 minutes, the circumference measured only 4 cm.

![Figure 1. CO₂ Absorption (post-inflation). Rapid absorption of CO₂ in the small bowel over time is illustrated here. Initial measurement of patient’s bowel wall circumference at maximum distention was 10 cm. Within two minutes, the wall measured 8 cm. After another 8 minutes, the circumference of the bowel was only 4 cm.](image)

The patient’s recovery was uneventful and she was discharged on the third post-operative day. One-hundred-and-twenty-day follow-up revealed the patient to be in good health without further bleeding.

Conclusion

In this case, carbon dioxide insufflation during IOE was associated with rapid absorption of the gas and, therefore, rapid resolution of bowel distention. This correlates to nonoperative states where CO₂ inflation decreases patient discomfort following colonoscopy and flexible sigmoidoscopy. In this facility’s experience, carbon dioxide inflation improves the surgical procedure associated with intraoperative endoscopy, since it allows easier abdominal closure when dealing with either open or laparoscopically-assisted intraoperative endoscopic exams.

References: