Improving Efficiency in Colonoscopy Using the Olympus ScopeGuide

Faculty

Steven Alan Gorcey, MD
Chief, Division of Gastroenterology
Monmouth Medical Center
Monmouth Gastroenterology
Eatontown, New Jersey
Assistant Clinical Professor
Drexel University College of Medicine
Philadelphia, Pennsylvania

Steven Lichtenstein, DO
Director, Division of Gastroenterology
Medical Director, Endoscopy/GI Lab
Mercy Fitzgerald Hospital
Clinical Associate Professor of Medicine
Philadelphia College of Osteopathic Medicine
Philadelphia, Pennsylvania

Introduction

Colonoscopy is arguably one of the most powerful tools for the diagnosis, management, and prevention of disease in modern medicine. However, this procedure is highly technical, and its success depends on many variables. These include patient- and disease-related factors, operator expertise, and the capabilities of the endoscope and its associated technology.[1,2]

For example, patient discomfort during the procedure and procedural time in the context of difficult anatomy increases the probability of complications and decreases the probability that procedural goals will be achieved. Factors contributing to patient discomfort during the procedure include loop formation, redundant colons, pelvic or other abdominal adhesions, and difficult or complex flexures.[3] Other difficulties in providing effective colonoscopies include administering appropriate amounts of anesthesia and the need to precisely document biopsy sites for serial examinations. These issues also make it harder for endoscopy trainees to achieve proficiency.[4,5]

This article reviews the use of the Olympus ScopeGuide technology in conjunction with colonoscopy as a mechanism to overcome these obstacles and to improve the success rate of endoscopic procedures, improve training, and reduce complications such as perforation and splenic hematoma.

Difficulties With Loop Formation

One problem that limits navigation through the gastrointestinal (GI) tract during colonoscopy is the formation of loops and the difficulty of mitigating or reducing these loops.[3] This problem arises, in part, from the inability to precisely map the configuration of the colonoscope as it courses through the GI tract. The excessive formation of loops can lead to complications such as perforation, trauma to the liver or spleen, or failure to achieve the goals of the procedure. Additionally, reducing looping may reduce patient pain and, therefore, decrease the need for anesthesia.[3]

Magnetic-Based Endoscopic Representation Technology

To improve procedural efficiency, mitigate loop formation, and increase patient comfort during colonoscopy, the magnetic-based Olympus ScopeGuide provides a real-time 3-dimensional (3D) representation of the shape and position of the colonoscope inside the body.[4]

Real-time visualization of the course of the scope is made possible through a small number of electromagnetic coils located within the colonoscope itself that generate a weak, low-frequency magnetic field (Figure 1).[4,6] Once an external receiver dish that is positioned close to the patient detects these pulses, the data are then relayed to a processor to generate a 3D representation of the scope alongside the endoscopic image (Figure 2).[6] The resulting image provides the endoscopist with the precise positioning and orientation of the scope during the procedure (Figure 1).[4,6]

Evaluating Loops With ScopeGuide

By seeing the shape of the entire scope as it moves through the body, ScopeGuide provides additional visual information that is particularly helpful during difficult colonoscopies. For example, the endoscopist can evaluate the extent and type of looping and get a better sense of which rotational maneuvers will be required to straighten out the specific loop formations (Figure 2).[6]

In addition to providing critical information for rotational maneuvers, the 3D representation generated by the equipment provides added functionality. For instance, an assistant can use a separate handheld 3D marker to visualize where abdominal pressure will be most effective in reducing loops and facilitating transit of the colonoscope. Specifically, by moving the hand coil across the patient's abdomen, the assistant is able to locate the precise position of the scope relative to the patient's body and can then apply hand pressure to the abdomen as needed, thus minimizing the likelihood of large loops forming (Figure 1).[6]

Clinical Studies

Several clinical studies have documented the utility of the ScopeGuide technology. In a preliminary study by Ambardar and colleagues, 3 experienced surgical endoscopists used the ScopeGuide technology to perform 78 outpatient colonoscopies over 5 months.[7] The researchers found that using ScopeGuide helped them discover loops and apply appropriate pressure in 28% of cases. In addition, the ScopeGuide technology identified loops, led to the appropriate application of pressure, and facilitated early position changes in 33% of the exams.[7]

Furthermore, Ignjatovic and colleagues studied the use of ScopeGuide versus non-use of ScopeGuide in 44 consecutive patients older than age 60 years who had features or history that predicted a difficult colonoscopy.[8] Median time taken to complete intubation to cecum in the ScopeGuide group was 6.6 minutes compared with 9.1 minutes for patients not using ScopeGuide. There also was a shorter duration of looping with the ScopeGuide technology (2.2 vs 4.3 min).[8]

Documenting Procedures

The information generated by this technology also can facilitate the functions of other members of the colonoscopy team. For example, information regarding the location of the colonoscope can help nurses document precise locations of biopsies and samples.[4] Similarly, gastroenterologists can use location-based information to document procedures in the patient's medical record using endoscopic and ScopeGuide images.[9] This type of information can be invaluable if repeat examinations are necessary, or if the patient requires subsequent surgical intervention.[10]

A study by Ellul and colleagues highlights the value of this information. Their team investigated the accuracy in determining the position of cancers detected during colonoscopy with the aid of ScopeGuide. After retrospectively reviewing records of patients in whom cancers were previously identified, the investigators reported that colonoscopy correctly identified tumor location in 93.75% of cases

Figure 1. Visualizing the gastrointestinal tract in real time with ScopeGuide.

(A) Real-time visualization of the course of the scope is made possible using built-in electromagnetic coils within the colonoscope that generate a weak low-frequency magnetic field.
(B) An external receiver dish that is positioned close to the patient detects these pulses. These data are then relayed to the processor to generate a 3-dimensional (3D) representation of the scope alongside the endoscopic image, providing the precise position and orientation of the scope during the procedure.
(C) An assistant can use a separate handheld 3D marker to visualize where to place abdominal pressure in order to reduce loops and facilitate transit of the colonoscope.

Images courtesy of Olympus.

using the ScopeGuide technology, whereas abdominopelvic computed tomography localized 82.5% of colon cancers.[4] Based on these data, the investigators concluded that ScopeGuide enabled accurate localization of cancers at colonoscopy and the technology may increase clinicians' confidence when localizing polypectomy sites that have not been tattooed.[4]

Improving Efficiency in Training And Patient Comfort

The technology also affords a unique opportunity to augment training efficacy for residents and subspecialty fellows who conduct endoscopic procedures. ScopeGuide provides visual cues to help trainees become proficient in estimating the configuration and orientation of the scope, as well as in rotational strategies designed to mitigate potential obstacles (Figure 3).[11] Kaltenbach and colleagues performed a study to assess the influence of the ScopeGuide technology on trainee colonoscopy performance. Blinded supervisors measured performance before and after individualized half-day sessions using a colonoscope training model and a colonoscope equipped with ScopeGuide.[11] Following the intervention, the colonoscopy performance score improved from 4.4±2.3 to 5.9±2.4 (P=0.005). Trainees had a 76% cecal intubation rate after the session with ScopeGuide compared with 43% before training (P=0.004), and procedural times were reduced from 18±11 minutes to 14±7 (P=0.056). Furthermore, less sedation and anesthesia were used after training with ScopeGuide (P>0.05).[11] Based on these data, the investigators concluded that colonoscopy simulation using the colonoscope training model and ScopeGuide immediately improved trainee colonoscopy performance in this small sample of trainees.[11]

ScopeGuide also may enhance patient comfort during colonoscopy. In the study by Ignjatovic and colleagues described earlier, median patient pain score in the ScopeGuide group was 4. However, when ScopeGuide was not used, the median pain score was 15.[8] Greater patient comfort and quicker procedural times might lead to a decrease in the need for patient sedation and anesthesia, as was indicated in the study by Kaltenbach and colleagues.[11]

Safety With ScopeGuide

As with the use of any device that discharges electrical current or that is associated with a magnetic field, there is a concern that these devices can interfere with implanted pacemaker or cardioverter defibrillator function.[12] In that regard, Corbett and colleagues performed a preliminary study of ScopeGuide in patients with permanent pacemakers or implantable cardioverter defibrillators.[12] After verifying that the magnetic field from ScopeGuide had no effect on the function of unimplanted cardiac devices ex vivo, investigators placed a colonoscope employing ScopeGuide on the abdomen over clothing of 100 patients with implanted cardiac devices. Cardiac monitoring and device interrogation were performed before, during, and after the mock procedure. There was no evidence of interference on device leads or change in programming following exposure to the electromagnetic field generated by ScopeGuide.[12] However, further study is needed before any definitive conclusions are reached regarding the safety of ScopeGuide technology in patients with implanted cardiac devices.

Figure 2. ScopeGuide display.

The ScopeGuide-generated image of the colonoscope's location is displayed alongside the intraluminal image captured by the endoscope itself.

Image courtesy of Olympus.

Conclusion

The formation of loops in the GI tract can hinder colonoscopy, making it more time-consuming and painful for patients, and cause severe and often life-threatening complications. ScopeGuide is designed to provide a real-time, 3D image of the shape and configuration of the colonoscope during a procedure. By seeing the shape of the entire scope as it moves through the body, ScopeGuide provides additional visual information that is unavailable with conventional colonoscopes, and is particularly helpful during difficult colonoscopies and training. Furthermore, this technology can enhance an easy colonoscopy by giving precise locations of polyps and lesions. Most importantly, the endoscopist is able to see loops form in real time and apply prophylactic pressure to reduce severe complications. Preventing large loops from forming enhances patient comfort, which may reduce anesthesia needs.

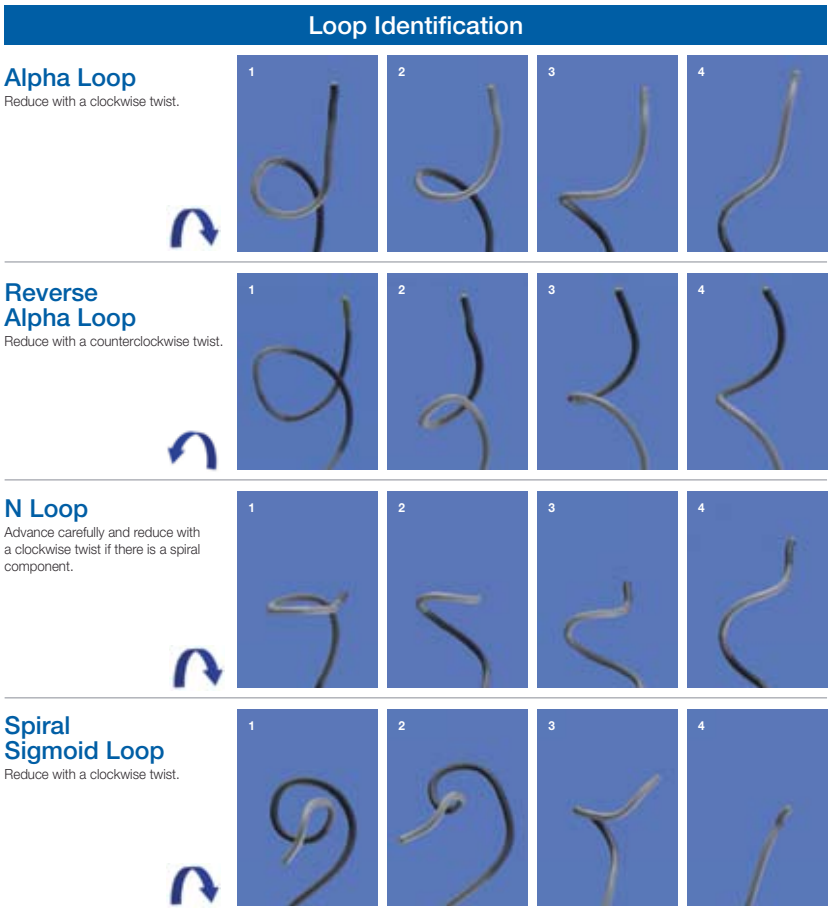

Figure 3. Maneuvers to mitigate loop formation.

Images courtesy of Olympus.

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