# Implementation of Image-enhanced Endoscopy into Solo and Group Practices for Dysplasia Detection in Crohn's Disease and Ulcerative Colitis

Rupert W. Leong, MD, FRACP[a], Rhys O. Butcher, MB ChB, MRCP[a], Michael F. Picco, MD, PhD, FACG[b,*]

**KEYWORDS**

• Ulcerative colitis • Crohn's colitis • Inflammatory bowel disease • Dysplasia
• Chromoendoscopy • Implementation

**KEY POINTS**

- Chromoendoscopy increases dysplasia detection in ulcerative colitis, and can be implemented across solo and group practices.
- Chromoendoscopy may not increase procedure time if the practice of random surveillance biopsies is abandoned.

## INTRODUCTION

Image-enhanced colonoscopy using chromoendoscopy (CE) with targeted biopsy has been shown to significantly improve dysplasia detection in inflammatory bowel disease (IBD) colitis. However, the more commonly practiced method for dysplasia detection in ulcerative colitis (UC) and Crohn's colitis in the United States has historically included the low-yielding process of multiple randomly obtained mucosal biopsies.[1–3] White-light colonoscopy alone, without the aid of enhanced imaging or detailed inspection, is imperfect and lacks acceptable sensitivity and specificity,[4,5] with the yield of random biopsy for dysplasia ranging from 0% to 0.2%.[6–9]

Dysplasia detection rates are significantly higher with CE,[7,10] such that CE with targeted biopsy is now recommended.[1,2] Adopting the technique into clinical practice

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[a] Gastroenterology and Liver Services, Concord Hospital, Sydney, Australia; [b] Division of Gastroenterology, Department of Medicine, Mayo Clinic, 4500 San Pablo Road, Jacksonville, FL 32224, USA
* Corresponding author.
*E-mail address:* picco.michael@mayo.edu

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has been perceived to be difficult because of availability, lack of endoscopist experience, reliability of image interpretation, cost, and the additional time needed to perform the procedure. This article reviews the commonly available technique of CE. From our own experience and study, suggestions are provided of the key steps for the implementation of CE into solo and group clinical practices for UC dysplasia surveillance.

## CE

### *The Technique*

CE involves the application of dye solutions (indigo carmine or methylene blue) onto the colonic mucosa to enhance contrast during surveillance colonoscopy.[11] Studies showing significantly higher yield of dysplasia detection using CE compared with white-light colonoscopy have used both dyes, with concentrations range from 0.03% to 0.4% for adequate mucosal enhancement. Indigo carmine is a plant-based dye that pools into the mucosal crevices and can subsequently be washed away. Methylene blue is a vital dye that is actively taken up by the colonic epithelium after approximately 60 seconds.[11] It has been associated with DNA damage of unclear clinical significance.[12]

Adequate colonic preparation quality is essential when using CE. As such, during colonoscope insertion, irrigate the colon using water and simethicone, and suction any remaining debris. The washing of residue during intubation thoroughly cleans the mucosa before the application of CE, and in turn improves the overall efficiency of the procedure. Once the cecum is reached and the mucosa is cleaned, exchange the water irrigation bottle for the dye solution, and initiate dye spraying. The diluted dye can then be sprayed onto the mucosa using a standard flushing pump attached to the scope, either through pressing a foot pedal or a programmed button on the endoscope handle (**Fig. 1**). Direct the spray to the antigravity side of the colon in order to optimize the dye application to all of the colonic mucosa in an efficient manner. Other studies and practices use a spray catheter for dye application, whereby the

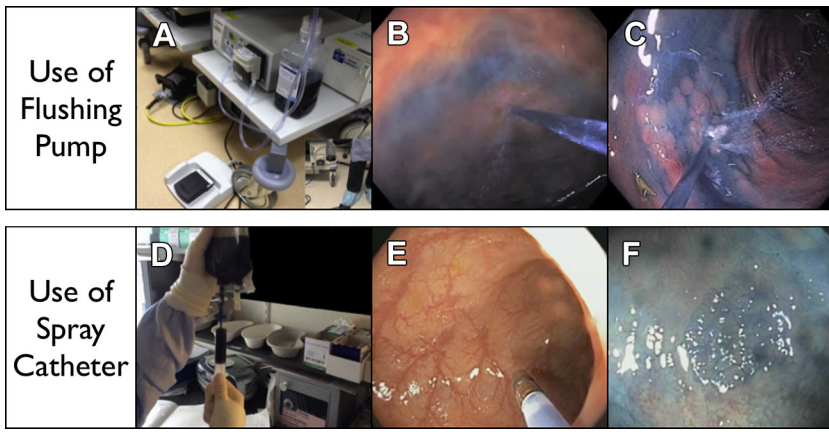


**Fig. 1.** Methods of application of CE. (*A*) Flushing pump with diluted CE solution in the irrigation bottle, and use of foot pump (*inset*). (*B*) CE spray onto colonic mucosa from the water channel can be seen during withdrawal. (*C*) During withdrawal, using CE, a nonpolypoid lesion is identified. (*D*) Preparation of diluted CE solution and transfer to syringes for spray catheter application. (*E*) Spray catheter is placed into the lumen and the CE solution is sprayed onto the mucosa during withdrawal (*F*).

endoscopist directs the catheter probe out of the endoscope accessory channel and the assistant continuously sprays the dye through the catheter using a 60-mL syringe while the endoscopist withdrawals the endoscope. The most recent descriptions and studies on CE using the flushing pump have shown it to be an efficient method of dye application because it eliminates the cost of the spray catheter as well as dependency on the assistant's spray catheter technique.

## IMPLEMENTATION INTO PRACTICE

The implementation of CE with targeted biopsy for surveillance of dysplasia in patients with IBD requires emphasis on standardization of procedure, quality assurance, and training (**Table 1**).

### *Quality*

The adoption of CE for UC dysplasia surveillance across solo and group practices requires the implementation of quality standards. Although the procedure is simple, its adequate performance requires acceptable dysplasia detection and procedure duration. Standardized procedures and reporting allow determination of minimal standards and the effect of CE on the development of colorectal cancer in UC. A transition period of combining targeted and random biopsy may be considered before abandoning random surveillance biopsies. Furthermore, it may be appropriate to identify 1 or a few endoscopists within a practice to perform the technique based on procedure volume, because outcomes may be improved with high volume.

In our study of 3 academic sites, we implemented the practice of CE for surveillance colonoscopy in patients with IBD initially through a research protocol.[13] We selected 6 gastroenterologists, who were not experts in IBD endoscopy, to participate. They reviewed the literature along with video examples as well as the practice protocol. Together, a pair of the participating endoscopists performed the initial procedures to review the technique and refine the protocol. There was eventual agreement on the CE technique using indigo carmine through the flushing pump. There was also agreement that any identified large lesion or one that would be technically difficulty to remove would be referred to an endoscopic resection expert within their group. We centrally recorded the procedure information.

### *Training*

The issue of training is important. The American Gastroenterological Association recommends CE with targeted biopsy, provided that there is expertise available. However, CE is not taught during fellowship and there has never been by any effort to train. Therefore, in practice, CE is not performed in the United States. How should clinicians train when there is no trainer?

Familiarity with the detection of the nonpolypoid colorectal neoplasms is a prerequisite. The nonpolypoid neoplasms have been recognized in the United States only since 2008; again, most endoscopists did not have the opportunity to learn about detection, diagnosis, and treatment during fellowship. Given of the paucity of trainers, we suggest self-learning. Several learning videos are available, particularly through the American Society for Gastrointestinal Endoscopy (ASGE) Online Learning Library. Start by learning the detection of nonpolypoid neoplasms in patients who do not have IBD, as well as learning image-enhanced endoscopy. A training video on the use of CE with targeted biopsy is now available through the ASGE Online Learning Library. The published descriptions of the nonpolypoid colorectal neoplasms in colitic IBD can also provide printed guidance and an atlas for these efforts.

**Table 1**
**Suggested steps for the implementation of CE into endoscopic practice**

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|---|---|
| **Equipment** | |
| Colonoscope | High-definition colonoscope, monitor, and cables |
| Accessories | Apply chromoendoscopy via:<br>Standard water pump attached to the endoscope activated via foot pedal<br>Or:<br>Dye-spray catheter<br>• Length: 240 cm<br>• Endoscope accessory channel: 2.8 mm<br>Single-use spray catheters:<br>• Olympus model PW-205V or Cook Medical Glo-Tip (GT-7-SPRAY)<br>• Cost: AU$100–171 per catheter<br>Reusable spray catheters:<br>• Olympus model PW-5V-1<br>• Cost: AU$200 per catheter |
| Contrast agent | Indigo carmine (Sigma-Aldrich)<br>• Cost: AU$37.80 per vial<br>• Dilution: 0.5% (topical application)<br>• For application via the foot pump, mix 2 vials of indigo carmine with 250 mL water (0.03%)<br>Methylene blue (50 mg in 5 mL, Phebra)<br>• Storage: <25°C<br>• Cost: AU$36.00 per vial<br>• Dilution: 0.1% (topical application) |
| **Procedure and Protocol** | |
| Time allotment | Consider initially during the learning curve period double colonoscopy time slot. Procedure times for CE have included random biopsies |
| Standard operating procedure | Complete colonoscopy to cecum<br>• Lavage with water and suction during intubation<br>Prepare contrast solution during insertion for application via the foot pump or spray<br>• Indigo carmine: mix 2 vials of indigo carmine with 250 mL water (0.03%)<br>• Indigo carmine: mix to indigo carmine with 1000cc water to obtain a concentration of 0.1 to 0.4%<br>If using a foot pump: once the cecum is intubated, the water irrigation can be exchanged with the contrast solution. Apply the CE in a circumferential technique withdrawing the colonoscope<br>If using a spray catheter: the dye-spray catheter is inserted into the working channel; the catheter tip should protrude 2–3 cm from the endoscope<br>• Apply catheter dye solution segmentally using a rotational technique, withdrawing the colonoscope at the same time to cover the surface mucosa with dye<br>Suction any excess solution after approximately 1 min to aid mucosal visualization<br>• Focus on segments of 20–30 cm sequentially with reinsertion of the endoscope to the proximal extent of each segment before slow withdrawal and mucosal visualization<br>Remove endoscopically resectable suspicious lesions using polypectomy or EMR<br>Take targeted biopsies of any nonresectable abnormality visualized through CE to diagnose dysplasia<br>Take biopsies of flat area surrounding lesions suspicious for dysplasia<br>Consider tattoo of suspicious dysplastic lesion arising from flat mucosa or not able to be completely removed<br>Take 2 random biopsies in every bowel segment to document microscopic disease activity |

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**Table 1**
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| | |
|---|---|
| **Biopsies** | |
| Circumscribed lesion | Biopsy of area surrounding lesion; lesions may be removed with polypectomy or EMR |
| Targeted and random biopsies | Targeted biopsies (can avoid random biopsies) of identified lesions in good-quality CE<br>Segmental random biopsies for disease activity documentation |
| **Training** | |
| Trainees | Gastroenterology fellows and attendings |
| In-service training for nursing staff | Recommended |
| Trainer | Specialized endoscopist: training video is also available from the ASGE Learning Library to familiarize clinicians with the technique and the appearance of nonpolypoid colorectal neoplasms |
| Learning curve | Consider transition period of CE with targeted and random biopsy<br>One study showed that endoscopists were partnered for the first 5 cases, and that procedure time plateaued at 15 cases |
| Learning environment and resources | Optimal setup of processor, monitor, and cables for optimal imaging<br>Endoscopy software with image capture<br>Endoscopy atlas<br>Training videos<br>Online resources<br>Multidisciplinary meetings |
| Ease of learning | |
| Technical | Simple |
| Image recognition | Moderate |
| **Quality Measures** | |
| Selection of colitis cases based on accepted surveillance guidelines | Recommended |
| Colonoscopy quality measures | Recommended, such as bowel preparation quality, cecal intubation rating, withdrawal times, adenoma detection |
| Completeness of procedure (photographs) | Recommended photographs of terminal ileum, cecum, and any lesion; in addition, consider segmental photographic documentation even if no lesion seen |
| Review of images | Recommended study of images after examination, as well as after review of pathology |
| GI pathologist's verification | Recommended |
| Audit | Recommended (concordance with biopsies); additional quality indicators may include total procedural time, yield of targeted biopsies, volume of contrast agent |

*Abbreviations:* ASGE, American Society for Gastrointestinal Endoscopy; EMR, endoscopic mucosal resection; GI, gastrointestinal.

In our CE implementation study, we assessed the feasibility of learning image interpretation. The 6 endoscopists underwent a short training session that consisted of viewing a teaching file of images and general instruction on the CE technique. Withdrawal times from the cecum and accuracy of image interpretation were measured.[13] Agreement of image interpretation was excellent for both white light and CE. Dysplasia detection rates were similar to published data from experts.

### *Procedure Time*

The additional procedure time to perform CE is also a potential barrier to implementation. In a meta-analysis from experienced centers, CE increased procedure time by 11 minutes overall.[10] For patients who underwent tandem colonoscopies (the first under white light followed by indigo carmine staining), median extubation times were 11 minutes and 10 minutes respectively.[8] In another study, CE increased colonoscopy time from 35 to 44 minutes overall.[14] However, most of the reported times have also included the time taken for random biopsy. If the practice of random biopsies was abandoned in favor of targeted biopsies based on enhanced imaging, overall procedure time may be affected little and cost savings may be realized by restricting biopsies to targeted lesions.

In our implementation study, we also observed a learning curve with the technique. Withdrawal time decreased with experience, ranging from 31 minutes for fewer than 5 procedures to 19 minutes for more than 15 procedures completed.[13]

## SUMMARY

CE with targeted colonic biopsies identifies dysplasia more readily than random biopsies and this evidence-based approach should therefore be adopted into group and solo practice.[1,2,15,16] The technique is easy and requires a low level of equipment. Mechanisms for its implementation include standardization of protocol and training, and ensuring quality metrics.

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