Comparison of linked color imaging and white-light colonoscopy for detection of colorectal polyps: a multicenter, randomized, crossover trial CME

Min Min, MD, PhD,[1,*] Pei Deng, MD, PhD,[1,*] Wenhua Zhang, MD, PhD,[2] Xiaomin Sun, MD, PhD,[3] Yan Liu, MD, PhD,[1] Bing Nong, MD, PhD[2]

Beijing, Guangxi, Shanghai, China

Background and Aims: Linked color imaging (LCI), a recently developed technology, uses a laser endoscopic system to enhance the color separation of red color to depict red and white colors more vividly. The benefits of LCI in the detection of colorectal polyps remain unknown. The aim of this study was to assess the ability of LCI to improve the detection of colorectal polyps compared with white-light (WL) endoscopy.

Methods: We performed a multicenter, crossover, prospective, randomized controlled trial in 3 hospitals in China. All patients underwent crossover colonoscopies with LCI and WL endoscopy in a randomized order. All lesions were removed during the second endoscopic procedure. The primary outcome measure was the difference in sensitivity between LCI and WL endoscopy for the detection of colorectal polyps. The secondary outcome measures were the adenoma detection rate per patient in the 2 groups and the factors associated with polyp miss rates.

Results: A total of 152 patients were randomized, and 141 were included in the analysis. The overall polyp detection rate increased significantly by 24% for LCI colonoscopy, corresponding to a higher sensitivity with LCI than with WL endoscopy (91% vs 73%, $P < .0001$). Furthermore, LCI identified significantly more patients (32%) with polyps. The per-patient adenoma detection rate was significantly higher for LCI than for WL endoscopy (37% vs 28%; 95% confidence interval, 2.39%-19.41%).

Conclusions: LCI improves the detection of colorectal polyps and adenomas during colonoscopy. (Clinical trial registration number: NCT02724397.) (Gastrointest Endosc 2017;86:724-30.)

INTRODUCTION

Colorectal cancer (CRC) arises from pre-existing adenomas over the course of many years, and the removal of such adenomas during colonoscopy can prevent CRC.[1] However, many polyps are missed during colonoscopy screening. Previous studies have shown a polyp miss rate of 20% to 26% during colonoscopy,[2,3] and reports of

Abbreviations: BBPS, Boston Bowel Preparation Scale; BLI, blue laser image; CRC, colorectal cancer; IEE, image-enhanced endoscopic; LCI, linked color imaging; NBI, narrow-band imaging; WL, white light.

DISCLOSURE: *All authors disclosed no financial relationships relevant to this publication.*

See CME section; p. 731.

*Drs Min and Deng contributed equally to this work.

Use your mobile device to scan this QR code and watch the author interview. Download a free QR code scanner by searching "QR Scanner" in your mobile device's app store.

0016-5107/$36.00
http://dx.doi.org/10.1016/j.gie.2017.02.035

Received December 2, 2016. Accepted February 23, 2017.

Current affiliations: Department of Gastroenterology and Hepatology, Affiliated Hospital of Academy of Military Medical Sciences, Beijing (1), Department of Gastroenterology and Hepatology, The People's Hospital of Guangxi Zhuang Autonomous Region, Nan Ning, Guangxi (2), Department of Gastroenterology and Hepatology, Shanghai Tenth People's Hospital, Shanghai, 200000, China (3).

Reprint requests: Professor Yan Liu, Department of Gastroenterology and Hepatology, Affiliated Hospital of Academy of Military Medical Sciences, Beijing, 100071, China or Professor Bing Nong, Department of Gastroenterology and Hepatology, The People's Hospital of Guangxi Zhuang Autonomous Region, Nanning, Guangxi, 530000, China.

If you would like to chat with an author of this article, you may contact Professor Liu at 13911798288@163.com or Professor Nong at nbinggx@qq.com.

missed cancers identified after colonoscopy have recently increased.[4,5] Furthermore, flat and depressed adenomas are often not visible during white-light (WL) endoscopy. Polyp detectability depends on many factors, and one of the most important factors is polyp visibility. Detection rates are expected to improve with optimized visualization methods. There is great interest in developing techniques that may improve polyp detection in the colorectal region during colonoscopy. Several image-enhanced endoscopic (IEE) systems that enhance the mucosal vasculature and/or architecture without the use of dye have been developed. Many clinical studies have reported an improvement in the detection rate of colonoscopy using IEE systems such as narrow-band imaging (NBI), flexible spectral imaging, and autofluorescence imaging.[6-8]

Linked color imaging (LCI) was recently developed and uses a laser endoscopic system (Fujifilm Co, Tokyo, Japan) that acquires images by simultaneously using narrow-band short-wavelength light and WL in an appropriate balance. LCI is a new image-enhancing technology that is intended to enhance slight color differences in the red region of the mucosa.[9] The acquired color information is reallocated to differentiate colors that are similar to the mucosal color, resulting in improved performance in depicting blood vessels, and additional image processing that enhances color separation for red color permits clear visualization of red blood vessels and white pits.[10] Bright LCI is available, even with non-magnifying endoscopes, and provides sufficient light intensity via the combined images of spectral laser light and WL that are produced by another spectral laser. This modality may increase the detection rate of colorectal polyps by enhancing the visibility of colonic mucosal vessels.

No published data are available regarding detection of colorectal polyps or adenomas with LCI. In this study, we performed a multicenter, randomized, crossover trial to compare the detection of colorectal polyps using LCI and WL endoscopy.

METHODS

Patients

This study was performed between May and September 2016 in 3 hospitals in China, including 1 academic hospital (Affiliated Hospital of Academy of Military Medical in Beijing) and 2 regional hospitals (The People's Hospital of Guangxi Zhuang Autonomous Region in Guangxi and Shanghai Tenth People's Hospital in Shanghai). Consecutive adult patients undergoing outpatient colonoscopy at the 3 hospitals were invited to participate in this prospective randomized study. Patients were excluded if they were unable to provide informed consent or had undergone previous resection of the colon, had inflammatory bowel disease, familial adenomatous polyposis, Peutz-Jeghers syndrome, or other polyposis syndromes. In addition, patients were excluded from randomization if either the cecum could not be intubated or the quality of the bowel preparation was inadequate (Boston Bowel Preparation Scale [BBPS] score <2 in any segment of the colon).[11]

All patients provided written informed consent to participate in this study. Eligible patients were randomly allocated 1:1 to either the LCI-WL or WL-LCI group. Randomization was performed using a computer-generated random number sequence and allocation was kept in a sealed envelope. The study was approved by the Institutional Review Board of the Affiliated Hospital of Academy of Military Medical according to the Consolidated Standards of Reporting Trials guidelines and was registered at ClinicalTrials.gov (study number: NCT02724397).

Study design

This study had a randomized crossover design (Fig. 1). Patients were randomly allocated to 1 of 2 arms: (1) LCI-WL group: first inspection with LCI followed by a second inspection with WL endoscopy; or (2) WL-LCI group: first inspection with WL endoscopy followed by a second inspection with LCI. After the first endoscopic procedure, the first endoscopist left the endoscopy suite, and a second experienced endoscopist, who was unaware of the results of the first endoscopic procedure, performed the second endoscopic procedure with the alternative endoscopic method. Polyps detected during the first examination were not removed immediately. All lesions were removed during the second procedure and sent for histology. The colon was divided into 6 segments (cecum, the ascending, transverse, descending, and sigmoid colon, and rectum), and in cases in which lesions were detected during the first endoscopic procedure but missed by the second procedure, an independent observer notified the endoscopist immediately after the endoscopist finished inspecting the relevant segment. All polyps that were 3 mm or larger were removed immediately during the second inspection. The size (measured with open biopsy forceps), location, and morphology of all polyps were noted on a case record form by an independent observer.

Endoscopic equipment and setting

All procedures were performed with a high-definition GF-L590WR endoscope that was part of a LASEREO endoscopic system (Fujifilm Co, Tokyo, Japan). This system has 2 lasers with different wavelengths. One is a WL laser (wavelength 450 ± 10 nm), which provides wide-spectrum WL illumination suitable for general observation. The other is a blue laser image (BLI) mode laser (wavelength 410 ± 10 nm) with a short wavelength and narrow band. The LCI technique used in the present study is a novel image-enhanced mode based on the BLI bright image with additional image processing that enhances the color separation of red colors, allowing more vivid visualization of red and white colors.