

World Journal of *Gastroenterology*

World J Gastroenterol 2019 August 14; 25(30): 4043-4293



**EDITORIAL**

- 4043** Exhaled breath analysis in hepatology: State-of-the-art and perspectives
De Vincentis A, Vespasiani-Gentilucci U, Sabatini A, Antonelli-Incalzi R, Picardi A

OPINION REVIEW

- 4051** Miniature gastrointestinal endoscopy: Now and the future
McGoran JJ, McAlindon ME, Iyer PG, Seibel EJ, Haidry R, Lovat LB, Sami SS
- 4061** Issues and controversies in esophageal inlet patch
Ciocalteu A, Popa P, Ionescu M, Gheonea DI

REVIEW

- 4074** Role of hepatocyte nuclear factor 4-alpha in gastrointestinal and liver diseases
Yeh MM, Bosch DE, Daoud SS
- 4092** G protein-coupled estrogen receptor in colon function, immune regulation and carcinogenesis
Jacenic D, Beswick EJ, Krajewska WM, Prossnitz ER
- 4105** *Helicobacter pylori* and cytokine gene variants as predictors of premalignant gastric lesions
Negovan A, Iancu M, Fülöp E, Bănescu C
- 4125** Intestinal enteroids/organoids: A novel platform for drug discovery in inflammatory bowel diseases
Yoo JH, Donowitz M

MINIREVIEWS

- 4148** Colorectal cancer surveillance in inflammatory bowel disease: Practice guidelines and recent developments
Clarke WT, Feuerstein JD
- 4158** Elderly patients with inflammatory bowel disease: Updated review of the therapeutic landscape
LeBlanc JF, Wiseman D, Lakatos PL, Bessissow T
- 4172** Reduced lysosomal acid lipase activity: A new marker of liver disease severity across the clinical continuum of non-alcoholic fatty liver disease?
Baratta F, Pastori D, Ferro D, Carluccio G, Tozzi G, Angelico F, Violi F, Del Ben M
- 4181** Beneficial effects of nutritional supplements on intestinal epithelial barrier functions in experimental colitis models *in vivo*
Vargas-Robles H, Castro-Ochoa KF, Citalán-Madrid AF, Schnoor M

- 4199 Multiple “Omics” data-based biomarker screening for hepatocellular carcinoma diagnosis

Liu XN, Cui DN, Li YF, Liu YH, Liu G, Liu L

ORIGINAL ARTICLE

Basic Study

- 4213 Novel magnetic compression technique for establishment of a canine model of tracheoesophageal fistula

Gao Y, Wu RQ, Lv Y, Yan XP

- 4222 Bone morphogenetic protein-7 represses hepatic stellate cell activation and liver fibrosis *via* regulation of TGF- β /Smad signaling pathway

Zou GL, Zuo S, Lu S, Hu RH, Lu YY, Yang J, Deng KS, Wu YT, Mu M, Zhu JJ, Zeng JZ, Zhang BF, Wu X, Zhao XK, Li HY

Retrospective Study

- 4235 Natural history of children with mild Crohn’s disease

Sharma Y, Bousvaros A, Liu E, Stern JB

Observational Study

- 4246 Inflammatory bowel disease patient profiles are related to specific information needs: A nationwide survey

Daher S, Khoury T, Benson A, Walker JR, Hammerman O, Kedem R, Naftali T, Eliakim R, Ben-Bassat O, Bernstein CN, Israeli E

SYSTEMATIC REVIEWS

- 4261 Frequency, localization, and types of gastrointestinal stromal tumor-associated neoplasia

Waidhauser J, Bornemann A, Trepel M, Märkl B

META-ANALYSIS

- 4278 Quantitative risk of positive family history in developing colorectal cancer: A meta-analysis

Mehraban Far P, Alshahrani A, Yaghoobi M

LETTER TO THE EDITOR

- 4292 Letter to the editor: Diagnosis of erythropoietic protoporphyria with severe liver injury - a case report

Wensink D, Wagenmakers MA, Wilson JP, Langendonk JG

ABOUT COVER

Editorial board member of *World Journal of Gastroenterology*, Yasemin H Balaban, MD, Doctor, Professor, Department of Gastroenterology, Hacettepe University, Ankara 06100, Turkey

AIMS AND SCOPE

World Journal of Gastroenterology (*World J Gastroenterol*, *WJG*, print ISSN 1007-9327, online ISSN 2219-2840, DOI: 10.3748) is a peer-reviewed open access journal. The *WJG* Editorial Board consists of 701 experts in gastroenterology and hepatology from 58 countries.

The primary task of *WJG* is to rapidly publish high-quality original articles, reviews, and commentaries in the fields of gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, hepatobiliary surgery, gastrointestinal oncology, gastrointestinal radiation oncology, etc. The *WJG* is dedicated to become an influential and prestigious journal in gastroenterology and hepatology, to promote the development of above disciplines, and to improve the diagnostic and therapeutic skill and expertise of clinicians.

INDEXING/ABSTRACTING

The *WJG* is now indexed in Current Contents®/Clinical Medicine, Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports®, Index Medicus, MEDLINE, PubMed, PubMed Central, and Scopus. The 2019 edition of Journal Citation Report® cites the 2018 impact factor for *WJG* as 3.411 (5-year impact factor: 3.579), ranking *WJG* as 35th among 84 journals in gastroenterology and hepatology (quartile in category Q2). CiteScore (2018): 3.43.

RESPONSIBLE EDITORS FOR THIS ISSUE

Responsible Electronic Editor: Yan-Liang Zhang

Proofing Production Department Director: Yun-Xiaojian Wu

NAME OF JOURNAL

World Journal of Gastroenterology

ISSN

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

LAUNCH DATE

October 1, 1995

FREQUENCY

Weekly

EDITORS-IN-CHIEF

Subrata Ghosh, Andrzej S Tarnawski

EDITORIAL BOARD MEMBERS

<http://www.wjgnet.com/1007-9327/editorialboard.htm>

EDITORIAL OFFICE

Ze-Mao Gong, Director

PUBLICATION DATE

August 14, 2019

COPYRIGHT

© 2019 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>



Colorectal cancer surveillance in inflammatory bowel disease: Practice guidelines and recent developments

William T Clarke, Joseph D Feuerstein

ORCID number: William Thomas Clarke (0000-0003-1067-6250); Joseph D Feuerstein (0000-0001-6126-3814).

Author contributions: Clarke WT and Feuerstein JD performed the literature review and wrote the paper.

Conflict-of-interest statement: All the Authors have no conflict of interest related to the manuscript.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Manuscript source: Invited manuscript

Received: May 5, 2019

Peer-review started: May 5, 2019

First decision: June 10, 2019

Revised: June 14, 2019

Accepted: July 2, 2019

Article in press: July 3, 2019

Published online: August 14, 2019

P-Reviewer: Cremers I, Fedeli U, Kim KJ

S-Editor: Yan JP

L-Editor: A

William T Clarke, Joseph D Feuerstein, Department of Medicine and Division of Gastroenterology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA 02215, United States

Corresponding author: Joseph D Feuerstein, MD, Assistant Professor, Attending Doctor, Department of Medicine and Division of Gastroenterology, Beth Israel Deaconess Medical Center, Harvard Medical School, 110 Francis St 8E, Boston, MA 02215, United States.

jfeuerst@bidmc.harvard.edu

Telephone: +1-617-6328623

Fax: +1-617-6329199

Abstract

Patients with long-standing inflammatory bowel disease (IBD) involving at least 1/3 of the colon are at increased risk for colorectal cancer (CRC). Advancements in CRC screening and surveillance and improved treatment of IBD has reduced CRC incidence in patients with ulcerative colitis and Crohn's colitis. Most cases of CRC are thought to arise from dysplasia, and recent evidence suggests that the majority of dysplastic lesions in patients with IBD are visible, in part thanks to advancements in high definition colonoscopy and chromoendoscopy. Recent practice guidelines have supported the use of chromoendoscopy with targeted biopsies of visible lesions rather than traditional random biopsies. Endoscopists are encouraged to endoscopically resect visible dysplasia and only recommend surgery when a complete resection is not possible. New technologies such as virtual chromoendoscopy are emerging as potential tools in CRC screening. Patients with IBD at increased risk for developing CRC should undergo surveillance colonoscopy using new approaches and techniques.

Key words: Inflammatory bowel disease; Colorectal cancer screening; Ulcerative colitis; Crohn's disease; Colonoscopy; Chromoendoscopy

©The Author(s) 2019. Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: The 2015 SCENIC guidelines provided updated recommendations on how to screen for colorectal cancer in patients with inflammatory bowel disease. These guidelines focused on the use of high definition colonoscopy and chromoendoscopy. There is ongoing debate and conflicting data as to whether white light endoscopy, chromoendoscopy or virtual chromoendoscopy should be the preferred method of surveillance and whether there is any benefit to random versus targeted biopsies. Visible dysplasia should be endoscopically resected when a complete resection is possible.

E-Editor: Zhang YL



Patients with special risk factors require a heightened surveillance protocol.

Citation: Clarke WT, Feuerstein JD. Colorectal cancer surveillance in inflammatory bowel disease: Practice guidelines and recent developments. *World J Gastroenterol* 2019; 25(30): 4148-4157

URL: <https://www.wjgnet.com/1007-9327/full/v25/i30/4148.htm>

DOI: <https://dx.doi.org/10.3748/wjg.v25.i30.4148>

INTRODUCTION

Patients with long-standing inflammatory bowel disease (IBD) involving at least 1/3 of the colon are at increased risk for developing colorectal cancer (CRC). Traditional CRC screening and surveillance for these patients at increased risk with ulcerative colitis (UC) and Crohn's colitis included random four quadrant biopsies every 10 cm. The 2015 SCENIC guidelines from the American Gastroenterological Association (AGA) and American Society for Gastrointestinal Endoscopy provided updated recommendations on how to screen for CRC^[1]. This review will focus on updates for CRC screening in patients with IBD since the publication of the 2015 SCENIC guidelines, with an emphasis on high-definition (HD) scopes, dye and virtual chromoendoscopy (CE), and random versus targeted biopsies.

BACKGROUND AND EPIDEMIOLOGY

CRC in IBD patients is thought to be preceded by unequivocal neoplastic epithelial changes known as dysplasia. Early detection of dysplasia is a primary goal of endoscopic surveillance. Riddell and colleagues described a classification system of no dysplasia, indefinite for dysplasia, low-grade dysplasia (LGD), and high-grade dysplasia (HGD) that is still used today^[2,3]. When the pathologist cannot distinguish between dysplastic and non-dysplastic atypia or inflammatory-associated changes, the sample is considered indefinite for dysplasia. LGD and HGD are differentiated based on the distribution of nuclei within the mucosa^[4]. There is high inter-observer variability in grading dysplasia among even experienced gastrointestinal pathologists, so guidelines recommend all cases of suspected dysplasia be reviewed by a second gastrointestinal pathologist^[5,6]. All dysplasia should be defined as invisible if obtained by random biopsies or visible if identified and removed or sampled by targeted biopsies^[7]. Furthermore, visible lesions should be classified by the endoscopist as polypoid or non-polypoid, as per the Paris classification^[1,8].

The incidence rate of CRC in IBD is approximately 18% after 30 years of colitis^[9-11]. However, recent population-based studies show a decreasing risk of CRC in IBD with improved medical therapy and CRC surveillance^[12-15]. The risk of CRC begins approximately 7 years after diagnosis and increases linearly thereafter. Factors increasing the risk of CRC include diagnosis at a young age, longer duration of disease, and severity of intestinal inflammation^[16-18]. Colonic strictures, pseudopolyps and a fore-shortened colon are all likely markers of prior inflammation and are associated with an increased risk of CRC^[2,16,19-21]. Family history increases the risk of CRC in IBD patients approximately 2-3 fold^[22,23] while primary sclerosing cholangitis (PSC) increases the risk of CRC and dysplasia with an odds ratio of 3.24 when compared to patients with IBD without PSC^[24].

ENDOSCOPIC SURVEILLANCE

Multiple case-control studies and population-based cohort studies have shown that endoscopic surveillance improves CRC-related survival in IBD patients at increased risk for colon cancer^[25-28]. Endoscopic surveillance is widely recommended by international gastrointestinal societies for the early detection and resection of dysplasia or CRC^[1,2,29-32]. Societal recommendations differ in details including when to perform initial and subsequent surveillance colonoscopies, the optimal methods of detecting dysplasia, and the management of dysplastic lesions (Table 1). There is consensus that patients with PSC should undergo annual surveillance. Otherwise, societies recommend surveillance intervals ranging from every 1-5 years based on a

number of risk factors including personal history of dysplasia, active inflammation, family history, and anatomic abnormalities such as inflammatory pseudopolyps, foreshortened colon and strictures.

Most guidelines recommend an initial screening colonoscopy with staging biopsies for all IBD patients 8 years after onset of symptoms to evaluate the disease extent and determine the need for ongoing surveillance^[2,29,32]. All societies recommend ongoing surveillance colonoscopies for patients with UC and Crohn's involving one-third of the colon or more than one segment. Dysplasia in IBD was previously thought to be flat and difficult to detect, so the historic recommended screening modality was white light endoscopy (WLE) with random four quadrant biopsies every 10 cm.

HD colonoscopy produces images with more pixels than standard definition (SD) colonoscopy, resulting in greater image detail. HD also allows for faster image refresh rates than SD, improving the display of moving objects^[33]. HD colonoscopy has been shown to result in higher adenoma detection than SD colonoscopy in patients undergoing screening colonoscopy^[34].

CE applies a blue contrast dye of indigo carmine or methylene blue to the colon epithelium, enhancing areas of mucosal irregularity and delineating borders of suspected lesions. Early studies including a 2013 meta-analysis by Soetikno *et al*^[35] found CE with targeted biopsies of abnormal appearing mucosa detected dysplasia 8.9 times more often than WLE alone. Other studies showed most dysplastic lesions are visible and targeted biopsies are superior to random biopsies^[35-37].

The 2015 SCENIC international consensus statement provided updated recommendations on how to screen for CRC in IBD with a focus on the use of HD colonoscopy and CE^[1]. Since the publication of these guidelines in 2015, many further studies have been published to further investigate the ideal colonoscopy surveillance method for patients with IBD.

Chromoendoscopy

SCENIC recommends CE over WLE when using SD colonoscopy but only suggests the use of CE over WLE when using HD colonoscopy^[1]. However, new evidence is conflicting as to the benefit of CE over WLE. Mooiweer *et al*^[38] from the Netherlands published a retrospective study in 2015 of more than 2200 colonoscopies over nearly 14 years and found no benefit in dysplasia detection from the use of CE. A 2017 meta-analysis by Iannone and colleagues showed that CE is superior to WLE only when compared to SD WLE; when compared to HD WLE, there was no benefit to CE, and CE was associated with longer procedure times^[39].

In support of CE is a prospective cohort study from Spain published in 2018. Carballal *et al*^[40] evaluated each colonic segment first with WLE and then with CE; the authors reported that 57.4% of dysplastic lesions were identified only with CE. Wan and colleagues published a 2019 meta-analysis including eleven studies that found CE was superior to WLE in detecting nonpolypoid dysplastic lesions and that the incremental yield of CE for detection of dysplasia was 9%^[41]. While statistically significant in both groups, the advantage to CE was greater in SD than in HD colonoscopy (relative risk 2.04 *vs* 1.60). A more recent study from Sekra *et al*^[42] evaluating 110 consecutive patients in a New Zealand tertiary care center found higher rates of dysplasia detection (risk difference 11.8%, $P = 0.008$) and dysplasia detection rates per patient (risk difference 20.6 lesions per 100 patients, $P = 0.003$) when using CE.

Similarly, a meta-analysis by Feuerstein *et al.* showed that CE was more effective in finding dysplasia per patient undergoing colonoscopy compared to SD but not when compared to HD colonoscopy. The study further showed that when evaluating studies with randomized control design methodology there was no difference between CE and HD. However, when CE was compared to non-randomized control design methodology CE was significantly more effective than SD and HD colonoscopy. However, this finding was likely more related to study design bias^[43].

Virtual chromoendoscopy

New technology in the field of virtual CE (VCE) is being actively investigated as an alternative to traditional dye-based CE. The SCENIC guidelines did not recommend the use of VCE with narrow band imaging (NBI) in place of WLE or CE^[1], but new studies have shown promising results.

In 2017, Bisschops *et al*^[44] published data showing no difference between NBI and CE with methylene blue in a multicenter prospective randomized clinical trial (RCT) of 131 patients with UC. In another RCT, Iacucci *et al*^[45] studied 270 patients and found the Pentax (Tokyo, Japan) branded VCE called HD iSCAN was non-inferior to traditional CE and HD WLE for detection of neoplastic lesions. Based partly on this data, the 2019 American College of Gastroenterology Clinical Guidelines for UC recommend CE or NBI when using HD colonoscopes^[46].

Table 1 Societal recommendations for colorectal cancer surveillance

Society	Surveillance intervals		
ACG (UC) 2019 ^[46]	Every 1-3 yr UC of any extent beyond the rectum Adjust intervals Based on previous colonoscopies and combined risk factors: Duration of disease, younger age at diagnosis, greater extent of inflammation, first-degree relative with CRC		
AGA 2010 ^[2]	Every 1-2 yr Extensive or left sided colitis. Every 1-3 yr After two negative exams	More frequent surveillance Ongoing endoscopic or histologic inflammation or History CRC in first degree relative or Anatomic abnormality <i>i.e.</i> , foreshortened colon, stricture or inflammatory pseudopolyps	Every year PSC
ASGE 2015	Beyond every 3 yr Endoscopically and histologically normal on two or more surveillance colonoscopies	Every 1-3 yr Average risk	Every year PSC or Active inflammation or History of dysplasia or History CRC in first degree relative or Anatomic abnormality <i>i.e.</i> , stricture, multiple pseudopolyps
BSG 2010 ^[30]	Every 5 yr Lower risk Extensive colitis with no active endoscopic or histologic inflammation or Left-sided colitis or Crohn's colitis with < 50% involvement	Every 3 yr Intermediate risk Extensive colitis with mild active endoscopic or histologic inflammation or Family history CRC in first degree relative > 50 or Post-inflammatory polyps	Every year Higher risk Extensive colitis with moderate to severe active endoscopic or histologic inflammation or PSC or Stricture in past 5 yr or Dysplasia in past 5 yr without surgery or Family history CRC in first degree relative < 50
ECCO 2017 ^[32]	Every 5 yr Absence of intermediate or high risk features	Every 2-3 yr Intermediate risk Extensive colitis with mild or moderate active inflammation or Post-inflammatory polyps or Family history CRC in first degree relative > 50	Every Year High risk PSC or Stricture or dysplasia detected within past 5 yr or Extensive colitis with severe active inflammation or Family history CRC in first degree relative < 50
NICE 2011 ^[76]	Every 5 yr Low risk Extensive but quiescent UC or Crohn's colitis or Left sided UC or Crohn's colitis	Every 3 yr Intermediate risk Extensive UC or Crohn's colitis with mild active inflammation or Post-inflammatory polyps or Family history CRC in first degree relative > 50	Every year High risk Extensive UC or Crohn's with moderate or severe active inflammation or PSC or Any dysplasia in last 5 yr or Colonic stricture in past 5 yr or Family history CRC in first degree relative < 50

CRC: Colorectal cancer; PSC: Primary sclerosing cholangitis; UC: Ulcerative colitis; BSG: British Society of Gastroenterology; ECCO: European Crohn's and Colitis Organization; NICE: National Institute for Health and Care Excellence; AGA: American Gastroenterological Association; ASGE: American Society of Gastrointestinal Endoscopy.

In non-IBD patients, NBI was shown to increase adenoma detection rate over WLE in the general population^[47], and iSCAN was shown to increase polyp detection in patients with Lynch syndrome, another group at high risk for CRC^[48]. While the SCENIC guidelines suggest that NBI is not beneficial in the evaluation of CRC screening and surveillance in IBD, multiple studies have shown a potential benefit of this technique. A meta-analysis of these studies show no difference in dysplasia per patient when comparing NBI and dye based CE. Based on this data there may be a role for NBI when evaluating potentially suspicious dysplastic lesions.

VCE has potential uses beyond dysplasia detection. To assess the accuracy and interobserver agreement of pit pattern recognition, endoscopists were given pictures of lesions using CE with methylene blue or NBI. There was superior interobserver agreement differentiating between neoplastic and non-neoplastic lesions using NBI in comparison to CE^[49]. Another study by Iacucci *et al*^[50] demonstrated iSCAN assessment of mucosal inflammation correlated strongly with histology.

New technologies

There is ongoing research into other new technologies to improve dysplasia detection. Panoramic views during colonoscopy were obtained by adding two side-viewing

cameras to the traditional forward-viewing camera. This “full-spectrum endoscopy” significantly improved dysplasia detection when compared to traditional forward view colonoscopy^[51]. Another new technology called autofluorescence was shown to be inferior to CE in a 2018 randomized controlled trial of 210 patients in Europe^[52].

Random biopsies

The benefit of random biopsies in surveillance colonoscopy is another area of controversy and ongoing research. The yield of neoplasia detection with random biopsies has been shown to be very low^[36,53]. Watanabe and colleagues performed a multi-center RCT of 246 patients comparing dysplasia detection in UC patients by random versus targeted biopsies. The authors found non-inferiority between the random and targeted biopsy groups although patients undergoing random biopsies had longer procedures and more biopsy samples^[53].

In a prospective, randomized, multicenter study with tandem colonoscopies, Leifeld *et al*^[54] found no difference in dysplasia detection between WLE with 40 random biopsies and NBI with 10 random biopsies; colonoscopies performed with NBI resulted in far fewer biopsy specimens (11.9 *vs* 38.6, $P < 0.001$) and a shorter withdrawal time (23 *vs* 13 min, $P < 0.001$). Results from a study by Gasia *et al*^[55] published in 2016 suggest random biopsies are still beneficial when using SD WLE but targeted biopsies are preferred over random biopsies in HD WLE, CE and VCE. Random biopsies in addition to CE are not currently recommended by the 2010 AGA or 2017 European Crohn’s and Colitis Organization guidelines^[2,32].

However, there are still circumstances in which random biopsies are beneficial. Random biopsies for histologic staging can still guide IBD treatment^[29,56]. In special circumstances such as a personal history of dysplasia, concomitant PSC or a foreshortened colon, random biopsies are still recommended regardless of the screening method^[57].

DYSPLASIA

Endoscopically visible dysplasia

Visible dysplastic lesions in parts of the colon uninvolved by colitis should be managed with standard polypectomy techniques, and surveillance should continue based on the patient’s underlying IBD risk without any need for increased surveillance or surgical resection^[2,29]. For polypoid and non-polypoid visible lesions with clear margins, endoscopic resection is recommended only if complete resection is possible^[58]. Features of underlying malignancy include ulcerated lesions, inability to lift with submucosal injection, and surrounding neoplastic changes and are associated with failed resection^[38]. In cases where the lesions are not endoscopically resectable, total proctocolectomy should be recommended^[2,7].

Referral to providers experienced in the removal of colorectal lesions in IBD patients should be considered as advanced techniques such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) may be necessary^[59]. However, only small studies have demonstrated success with these techniques^[60-63]. Importantly, the long-term efficacy of these techniques in preventing surgery or malignancy is still unclear. In all cases, whenever a larger polyp is removed, a tattoo should be placed to aid in locating the lesion and future surveillance. Guidelines also recommend obtaining additional biopsies of the flat mucosa surrounding the polypectomy site to evaluate for adjacent dysplasia^[2,7,56]. However, studies from The Netherlands in 2017 and England in 2018 report that these additional biopsies are rarely beneficial^[64,65].

Patients with dysplastic polypoid lesions that have been completely resected should undergo close endoscopic surveillance, although the ideal timing of subsequent procedures is unclear^[66,67]. In cases of EMR and ESD, the Global Interventional IBD Group recommends a follow-up surveillance colonoscopy with CE and biopsies at the resection site three months after resection^[58].

Endoscopically invisible dysplasia

Endoscopically invisible dysplasia is associated with a high rate of synchronous CRC, up to 22% with invisible LGD and 45%-67% with invisible HGD^[10,68-71]. However, in many cases of invisible dysplasia in older studies would possibly be visible today with HD WLE and CE.

Any endoscopically invisible dysplasia discovered at the time of random biopsies should be confirmed with a pathologist experienced in IBD given the significant inter-observer variability in the diagnosis of IBD associated dysplasia^[5,72]. Guidelines from 2015 also recommend patients with invisible dysplasia be referred to an experienced

provider for a repeat HD colonoscopy with CE and repeat random biopsies^[1,29]. If visible lesions are present repeat colonoscopy, resection and further surveillance can be considered. If LGD or no dysplasia is present, discussions about the risks and benefits of continued vigilant surveillance versus proctocolectomy should be initiated. Studies in this group are limited, but Navaneethan and colleagues reported in 2013 on 102 patients with LGD and found that with a median follow-up of 36 months, only 5 patients (4.9%) progressed from LGD to either HGD or CRC^[73]. In cases of endoscopically invisible HGD or multifocal LGD, total proctocolectomy should be recommended^[2,7].

POUCH SURVEILLANCE

For IBD patients who have undergone colectomy with ileal pouch anal anastomosis (IPAA), development of dysplasia in the anorectal or ileal pouch mucosa is rare. A 2014 study of 1200 patients with IBD and IPAA in the Netherlands over 20 years found only 1.8% developed pouch neoplasia and 1.3% developed adenocarcinoma^[74]. Risk factors for dysplasia following IPAA include a history of dysplasia or CRC, history of PSC, refractory pouchitis, and severely inflamed atrophic pouch mucosa^[74,75]. Patients with these risk factors should be considered for annual surveillance including biopsies in the pouch and within the anal transition zone^[29]. Many suggest surveillance every 3 years for patients with IPAA but without risk factors, but the optimal interval is unknown.

CONCLUSIONS AND FUTURE RESEARCH

Patients with UC and Crohn's colitis involving more than one-third of the colon are at increased risk for CRC and should undergo regular surveillance colonoscopies as early identification of dysplasia is critical to prevent CRC. Advances in technology have allowed for better identification of dysplasia, and recent data suggest that the majority of dysplastic lesions are visible. With the use of HD endoscopy, there will be continued debate over the role of CE with targeted biopsies versus HD WLE with random biopsies. With improved identification of dysplasia, there is an increasing effort to remove any endoscopically resectable visible dysplasia and only recommend surgical resection when endoscopic resection is not possible. Continued research is needed into the outcomes of endoscopically resected dysplasia, new technologies such as VCE and whether traditional surveillance intervals are still appropriate.

REFERENCES

- 1 Laine L, Kaltenbach T, Barkun A, McQuaid KR, Subramanian V, Soetikno R; SCENIC Guideline Development Panel. SCENIC international consensus statement on surveillance and management of dysplasia in inflammatory bowel disease. *Gastroenterology* 2015; **148**: 639-651.e28 [PMID: 25702852 DOI: 10.1053/j.gastro.2015.01.031]
- 2 Farrar FA, Odze RD, Eaden J, Itzkowitz SH. AGA technical review on the diagnosis and management of colorectal neoplasia in inflammatory bowel disease. *Gastroenterology* 2010; **138**: 746-774, 774.e1-4; quiz e12-13 [PMID: 20141809 DOI: 10.1053/j.gastro.2009.12.035]
- 3 Riddell RH, Goldman H, Ransohoff DF, Appelman HD, Fenoglio CM, Haggitt RC, Ahren C, Correa P, Hamilton SR, Morson BC. Dysplasia in inflammatory bowel disease: Standardized classification with provisional clinical applications. *Hum Pathol* 1983; **14**: 931-968 [PMID: 6629368 DOI: 10.1016/S0046-8177(83)80175-0]
- 4 Itzkowitz SH, Harpaz N. Diagnosis and management of dysplasia in patients with inflammatory bowel diseases. *Gastroenterology* 2004; **126**: 1634-1648 [PMID: 15168373 DOI: 10.1053/j.gastro.2004.03.025]
- 5 Feakins RM; British Society of Gastroenterology. Inflammatory bowel disease biopsies: Updated British Society of Gastroenterology reporting guidelines. *J Clin Pathol* 2013; **66**: 1005-1026 [PMID: 23999270 DOI: 10.1136/jclinpath-2013-201885]
- 6 Rubin DT, Turner JR. Surveillance of dysplasia in inflammatory bowel disease: The gastroenterologist-pathologist partnership. *Clin Gastroenterol Hepatol* 2006; **4**: 1309-1313 [PMID: 17110299 DOI: 10.1016/j.cgh.2006.09.010]
- 7 Annese V, Daperno M, Rutter MD, Amiot A, Bossuyt P, East J, Ferrante M, Götz M, Katsanos KH, Kießlich R, Ordás I, Repici A, Rosa B, Sebastian S, Kucharzik T, Eliakim R; European Crohn's and Colitis Organisation. European evidence based consensus for endoscopy in inflammatory bowel disease. *J Crohns Colitis* 2013; **7**: 982-1018 [PMID: 24184171 DOI: 10.1016/j.crohns.2013.09.016]
- 8 The Paris endoscopic classification of superficial neoplastic lesions: Esophagus, stomach, and colon: November 30 to December 1, 2002. *Gastrointest Endosc* 2003; **58**: S3-43 [PMID: 14652541 DOI: 10.1016/S0016-5107(03)02159-X]
- 9 Gillen CD, Walmsley RS, Prior P, Andrews HA, Allan RN. Ulcerative colitis and Crohn's disease: A comparison of the colorectal cancer risk in extensive colitis. *Gut* 1994; **35**: 1590-1592 [PMID: 7828978 DOI: 10.1136/gut.35.11.1590]
- 10 Friedman S, Rubin PH, Bodian C, Harpaz N, Present DH. Screening and surveillance colonoscopy in

- chronic Crohn's colitis: Results of a surveillance program spanning 25 years. *Clin Gastroenterol Hepatol* 2008; **6**: 993-8; quiz 953-4 [PMID: 18585966 DOI: 10.1016/j.cgh.2008.03.019]
- 11 **Munkholm P.** Review article: The incidence and prevalence of colorectal cancer in inflammatory bowel disease. *Aliment Pharmacol Ther* 2003; **18** Suppl 2: 1-5 [PMID: 12950413 DOI: 10.1046/j.1365-2036.18.s2.2.x]
 - 12 **Zhu Z, Mei Z, Guo Y, Wang G, Wu T, Cui X, Huang Z, Zhu Y, Wen D, Song J, He H, Xu W, Cui L, Liu C.** Reduced Risk of Inflammatory Bowel Disease-associated Colorectal Neoplasia with Use of Thiopurines: A Systematic Review and Meta-analysis. *J Crohns Colitis* 2018; **12**: 546-558 [PMID: 29370346 DOI: 10.1093/ecco-jcc/jjy006]
 - 13 **Greuther T, Scharl S, Barthel C, Rosse J-B, Biedermann L, Misselwitz B, Vavricka S, Rogler G, Scharl M; On Behalf of the Swiss IBD Cohort Study Group.** OP037 Risk of cancer in inflammatory bowel disease patients is associated with age and recent use of immunomodulators, while biologics and aminosalicylates are protective factors: A cross-sectional and follow-up analysis of the Swiss IBD cohort study. European Crohn's and Colitis Organisation Congress. 2018. Available from: <https://www.ecco-ibd.eu/publications/congress-abstract-s/abstracts-2018/item/op037-risk-of-cancer-in-inflammatory-bowel-disease-patients-is-associated-with-age-and-recent-use-of-immunomodulators-while-biologics-and-aminosalicylates-are-protective-factors-a-cross-sectional-and-follow-up-analysis-of-the-swiss-ibd-cohort-study.html>
 - 14 **Mooiweer E, van der Meulen-de Jong AE, Ponsioen CY, van der Woude CJ, van Bodegraven AA, Jansen JM, Mahmood N, Kremer W, Siersema PD, Oldenburg B; Dutch Initiative on Crohn's and Colitis.** Incidence of Interval Colorectal Cancer Among Inflammatory Bowel Disease Patients Undergoing Regular Colonoscopic Surveillance. *Clin Gastroenterol Hepatol* 2015; **13**: 1656-1661 [PMID: 25956835 DOI: 10.1016/j.cgh.2015.04.183]
 - 15 **Choi CH, Rutter MD, Askari A, Lee GH, Warusavitarne J, Moorghen M, Thomas-Gibson S, Saunders BP, Graham TA, Hart AL.** Forty-Year Analysis of Colonoscopic Surveillance Program for Neoplasia in Ulcerative Colitis: An Updated Overview. *Am J Gastroenterol* 2015; **110**: 1022-1034 [PMID: 25823771 DOI: 10.1038/ajg.2015.65]
 - 16 **Lutgens M, Vermeire S, Van Oijen M, Vleggaar F, Siersema P, van Assche G, Rutgeerts P, Oldenburg B; Dutch Initiative on Crohn and Colitis.** A rule for determining risk of colorectal cancer in patients with inflammatory bowel disease. *Clin Gastroenterol Hepatol* 2015; **13**: 148-54.e1 [PMID: 25041864 DOI: 10.1016/j.cgh.2014.06.032]
 - 17 **Ekbom A, Helmick C, Zack M, Adami HO.** Ulcerative colitis and colorectal cancer. A population-based study. *N Engl J Med* 1990; **323**: 1228-1233 [PMID: 2215606 DOI: 10.1056/NEJM199011013231802]
 - 18 **Flores BM, O'Connor A, Moss AC.** Impact of mucosal inflammation on risk of colorectal neoplasia in patients with ulcerative colitis: A systematic review and meta-analysis. *Gastrointest Endosc* 2017; **86**: 1006-1011.e8 [PMID: 28750838 DOI: 10.1016/j.gie.2017.07.028]
 - 19 **Beaugerie L, Itzkowitz SH.** Cancers complicating inflammatory bowel disease. *N Engl J Med* 2015; **372**: 1441-1452 [PMID: 25853748 DOI: 10.1056/NEJMra1403718]
 - 20 **Rutter MD, Saunders BP, Wilkinson KH, Rumbles S, Schofield G, Kamm MA, Williams CB, Price AB, Talbot IC, Forbes A.** Cancer surveillance in longstanding ulcerative colitis: Endoscopic appearances help predict cancer risk. *Gut* 2004; **53**: 1813-1816 [PMID: 15542520 DOI: 10.1136/gut.2003.038505]
 - 21 **Fumery M, Pineton de Chambrun G, Stefanescu C, Buisson A, Beaugerie L, Amiot A, Altwegg R, Savoye G, Abitbol V, Bouguen G, Simon M, Duffas JP, Hébuterne X, Nancey S, Roblin X, Leteurtre E, Bommelaer G, Lefevre JH, Brunetti F, Guillon F, Bouhnik Y, Peyrin-Biroulet L.** Detection of Dysplasia or Cancer in 3.5% of Patients With Inflammatory Bowel Disease and Colonic Strictures. *Clin Gastroenterol Hepatol* 2015; **13**: 1770-1775 [PMID: 26001338 DOI: 10.1016/j.cgh.2015.04.185]
 - 22 **Nuako KW, Ahlquist DA, Mahoney DW, Schaid DJ, Siems DM, Lindor NM.** Familial predisposition for colorectal cancer in chronic ulcerative colitis: A case-control study. *Gastroenterology* 1998; **115**: 1079-1083 [PMID: 9797361 DOI: 10.1016/S0016-5085(98)70077-0]
 - 23 **Askling J, Dickman PW, Karlén P, Broström O, Lapidus A, Löfberg R, Ekbom A.** Family history as a risk factor for colorectal cancer in inflammatory bowel disease. *Gastroenterology* 2001; **120**: 1356-1362 [PMID: 11313305 DOI: 10.1053/gast.2001.24052]
 - 24 **Zheng HH, Jiang XL.** Increased risk of colorectal neoplasia in patients with primary sclerosing cholangitis and inflammatory bowel disease: A meta-analysis of 16 observational studies. *Eur J Gastroenterol Hepatol* 2016; **28**: 383-390 [PMID: 26938805 DOI: 10.1097/MEG.0000000000000576]
 - 25 **Löfberg R, Broström O, Karlén P, Tribukait B, Ost A.** Colonoscopic surveillance in long-standing total ulcerative colitis—a 15-year follow-up study. *Gastroenterology* 1990; **99**: 1021-1031 [PMID: 2394325 DOI: 10.1016/0016-5085(90)90622-8]
 - 26 **Lutgens MW, Oldenburg B, Siersema PD, van Bodegraven AA, Dijkstra G, Hommes DW, de Jong DJ, Stokkers PC, van der Woude CJ, Vleggaar FP.** Colonoscopic surveillance improves survival after colorectal cancer diagnosis in inflammatory bowel disease. *Br J Cancer* 2009; **101**: 1671-1675 [PMID: 19826420 DOI: 10.1038/sj.bjc.6605359]
 - 27 **Eaden J, Abrams K, Ekbom A, Jackson E, Mayberry J.** Colorectal cancer prevention in ulcerative colitis: A case-control study. *Aliment Pharmacol Ther* 2000; **14**: 145-153 [PMID: 10651654 DOI: 10.1046/j.1365-2036.2000.00698.x]
 - 28 **Ananthakrishnan AN, Cagan A, Cai T, Gainer VS, Shaw SY, Churchill S, Karlson EW, Murphy SN, Kohane I, Liao KP.** Colonoscopy is associated with a reduced risk for colon cancer and mortality in patients with inflammatory bowel diseases. *Clin Gastroenterol Hepatol* 2015; **13**: 322-329.e1 [PMID: 25041865 DOI: 10.1016/j.cgh.2014.07.018]
 - 29 **American Society for Gastrointestinal Endoscopy Standards of Practice Committee.** Shergill AK, Lightdale JR, Bruining DH, Acosta RD, Chandrasekhara V, Chathadi KV, Decker GA, Early DS, Evans JA, Fanelli RD, Fisher DA, Fonkalsrud L, Foley K, Hwang JH, Jue TL, Khashab MA, Muthusamy VR, Pasha SF, Saltzman JR, Sharaf R, Cash BD, DeWitt JM. The role of endoscopy in inflammatory bowel disease. *Gastrointest Endosc* 2015; **81**: 1101-21.e1-13 [PMID: 25800660 DOI: 10.1016/j.gie.2014.10.030]
 - 30 **Cairns SR, Scholefield JH, Steele RJ, Dunlop MG, Thomas HJ, Evans GD, Eaden JA, Rutter MD, Atkin WP, Saunders BP, Lucassen A, Jenkins P, Fairclough PD, Woodhouse CR; British Society of Gastroenterology; Association of Coloproctology for Great Britain and Ireland.** Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). *Gut* 2010; **59**: 666-689 [PMID: 20427401 DOI: 10.1136/gut.2009.179804]
 - 31 **Gomollón F, Dignass A, Annese V, Tilg H, Van Assche G, Lindsay JO, Peyrin-Biroulet L, Cullen GJ, Daperno M, Kucharzik T, Rieder F, Almer S, Armuzzi A, Harbord M, Langhorst J, Sans M, Chowers Y,**

- Fiorino G, Juillerat P, Mantzaris GJ, Rizzello F, Vavricka S, Gionchetti P; ECCO. 3rd European Evidence-based Consensus on the Diagnosis and Management of Crohn's Disease 2016: Part 1: Diagnosis and Medical Management. *J Crohns Colitis* 2017; **11**: 3-25 [PMID: 27660341 DOI: 10.1093/ecco-jcc/jjw168]
- 32 **Magro F**, Gionchetti P, Eliakim R, Ardizzone S, Armuzzi A, Barreiro-de Acosta M, Burisch J, Gecse KB, Hart AL, Hindryckx P, Langner C, Limdi JK, Pellino G, Zagorowicz E, Raine T, Harbord M, Rieder F; European Crohn's and Colitis Organisation [ECCO]. Third European Evidence-based Consensus on Diagnosis and Management of Ulcerative Colitis. Part 1: Definitions, Diagnosis, Extra-intestinal Manifestations, Pregnancy, Cancer Surveillance, Surgery, and Ileo-anal Pouch Disorders. *J Crohns Colitis* 2017; **11**: 649-670 [PMID: 28158501 DOI: 10.1093/ecco-jcc/jjx008]
- 33 **ASGE Technology Committee**. High-definition and high-magnification endoscopes. *Gastrointest Endosc* 2014; **80**: 919-927 [PMID: 25442091 DOI: 10.1016/j.gie.2014.06.019]
- 34 **Buchner AM**, Shahid MW, Heckman MG, McNeil RB, Cleveland P, Gill KR, Schore A, Ghabril M, Raimondo M, Gross SA, Wallace MB. High-definition colonoscopy detects colorectal polyps at a higher rate than standard white-light colonoscopy. *Clin Gastroenterol Hepatol* 2010; **8**: 364-370 [PMID: 19932768 DOI: 10.1016/j.cgh.2009.11.009]
- 35 **Soetikno R**, Subramanian V, Kaltenbach T, Rouse RV, Sanduleanu S, Suzuki N, Tanaka S, McQuaid K. The detection of nonpolypoid (flat and depressed) colorectal neoplasms in patients with inflammatory bowel disease. *Gastroenterology* 2013; **144**: 1349-1352, 1352.e1-1352.e6 [PMID: 23583483 DOI: 10.1053/j.gastro.2013.04.008]
- 36 **van den Broek FJ**, Stokkers PC, Reitsma JB, Boltjes RP, Ponsioen CY, Fockens P, Dekker E. Random biopsies taken during colonoscopic surveillance of patients with longstanding ulcerative colitis: Low yield and absence of clinical consequences. *Am J Gastroenterol* 2014; **109**: 715-722 [PMID: 21427710 DOI: 10.1038/ajg.2011.93]
- 37 **Rutter MD**, Saunders BP, Wilkinson KH, Kamm MA, Williams CB, Forbes A. Most dysplasia in ulcerative colitis is visible at colonoscopy. *Gastrointest Endosc* 2004; **60**: 334-339 [PMID: 15332019 DOI: 10.1016/S0016-5107(04)01710-9]
- 38 **Mooiweer E**, van der Meulen-de Jong AE, Ponsioen CY, Fidder HH, Siersema PD, Dekker E, Oldenburg B. Chromoendoscopy for Surveillance in Inflammatory Bowel Disease Does Not Increase Neoplasia Detection Compared With Conventional Colonoscopy With Random Biopsies: Results From a Large Retrospective Study. *Am J Gastroenterol* 2015; **110**: 1014-1021 [PMID: 25823770 DOI: 10.1038/ajg.2015.63]
- 39 **Iannone A**, Ruospo M, Wong G, Principi M, Barone M, Strippoli GFM, Di Leo A. Chromoendoscopy for Surveillance in Ulcerative Colitis and Crohn's Disease: A Systematic Review of Randomized Trials. *Clin Gastroenterol Hepatol* 2017; **15**: 1684-1697.e11 [PMID: 27890853 DOI: 10.1016/j.cgh.2016.11.021]
- 40 **Carballal S**, Maisterra S, López-Serrano A, Gimeno-García AZ, Vera MI, Marín-Gabriel JC, Díaz-Tasende J, Márquez L, Álvarez MA, Hernández L, De Castro L, Gordillo J, Puig I, Vega P, Bustamante-Balén M, Acevedo J, Peñas B, López-Cerón M, Ricart E, Cuatrecasas M, Jimeno M, Pellisé M; EndoCAR group of the Spanish Gastroenterological Association and Spanish Digestive Endoscopy Society. Real-life chromoendoscopy for neoplasia detection and characterisation in long-standing IBD. *Gut* 2018; **67**: 70-78 [PMID: 27612488 DOI: 10.1136/gutjnl-2016-312332]
- 41 **Wan J**, Wang X, Yang ZP, Wu KC. Systematic review with meta-analysis: Chromoendoscopy versus white light endoscopy in detection of dysplasia in patients with inflammatory bowel disease. *J Dig Dis* 2019; **20**: 206-214 [PMID: 30756472 DOI: 10.1111/1751-2980.12714]
- 42 **Sekra A**, Schauer C, Mills L, Vandal AC, Rose T, Lal D, Ogra R. Chromoendoscopy versus standard colonoscopy for detection of nonpolypoid dysplasia in patients with inflammatory bowel disease. *N Z Med J* 2018; **131**: 32-38 [PMID: 30001304]
- 43 **Feuerstein JD**, Rakowsky S, Sattler L, Yadav A, Foromera J, Grossberg L, Cheifetz AS. Meta-analysis of dye-based chromoendoscopy compared with standard- and high-definition white-light endoscopy in patients with inflammatory bowel disease at increased risk of colon cancer. *Gastrointest Endosc* 2019; pii: S0016-5107(19)31602-5 [PMID: 31009609 DOI: 10.1016/j.gie.2019.04.219]
- 44 **Bisschops R**, Bessissow T, Joseph JA, Baert F, Ferrante M, Ballet V, Willekens H, Demedts I, Geboes K, De Hertogh G, Vermeire S, Rutgeerts P, Van Assche G. Chromoendoscopy versus narrow band imaging in UC: A prospective randomised controlled trial. *Gut* 2018; **67**: 1087-1094 [PMID: 28698230 DOI: 10.1136/gutjnl-2016-313213]
- 45 **Iacucci M**, Kaplan GG, Panaccione R, Akinola O, Lethebe BC, Lowerison M, Leung Y, Novak KL, Seow CH, Urbanski S, Minoo P, Gui X, Ghosh S. A Randomized Trial Comparing High Definition Colonoscopy Alone With High Definition Dye Spraying and Electronic Virtual Chromoendoscopy for Detection of Colonic Neoplastic Lesions During IBD Surveillance Colonoscopy. *Am J Gastroenterol* 2018; **113**: 225-234 [PMID: 29134964 DOI: 10.1038/ajg.2017.417]
- 46 **Rubin DT**, Ananthakrishnan AN, Siegel CA, Sauer BG, Long MD. ACG Clinical Guideline: Ulcerative Colitis in Adults. *Am J Gastroenterol* 2019; **114**: 384-413 [PMID: 30840605 DOI: 10.14309/ajg.0000000000000152]
- 47 **Atkinson NSS**, Ket S, Bassett P, Aponte D, De Aguiar S, Gupta N, Horimatsu T, Ikematsu H, Inoue T, Kaltenbach T, Leung WK, Matsuda T, Paggi S, Radaelli F, Rastogi A, Rex DK, Sabbagh LC, Saito Y, Sano Y, Saracco GM, Saunders BP, Senore C, Soetiko R, Vemulapalli KC, Jairath V, East JE. Narrow-band Imaging for Detection of Neoplasia at Colonoscopy: A Meta-analysis of Data From Individual Patients in Randomized Controlled Trials. *Gastroenterology* 2019; pii: S0016-5085(19)35708-7 [PMID: 30998991 DOI: 10.1053/j.gastro.2019.04.014]
- 48 **Bisschops R**, Tejpar S, Willekens H, De Hertogh G, Van Cutsem E. Virtual chromoendoscopy (I-SCAN) detects more polyps in patients with Lynch syndrome: A randomized controlled crossover trial. *Endoscopy* 2017; **49**: 342-350 [PMID: 28107763 DOI: 10.1055/s-0042-121005]
- 49 **Bisschops R**, Bessissow T, Dekker E, East JE, Para-Blanco A, Ragunath K, Bhandari P, Rutter M, Schoon E, Wilson A, John JM, Van Steen K, Baert F, Ferrante M. Pit pattern analysis with high-definition chromoendoscopy and narrow-band imaging for optical diagnosis of dysplasia in patients with ulcerative colitis. *Gastrointest Endosc* 2017; **86**: 1100-1106.e1 [PMID: 28986266 DOI: 10.1016/j.gie.2017.09.024]
- 50 **Iacucci M**, Kiesslich R, Gui X, Panaccione R, Heatherington J, Akinola O, Ghosh S. Beyond white light: Optical enhancement in conjunction with magnification colonoscopy for the assessment of mucosal healing in ulcerative colitis. *Endoscopy* 2017; **49**: 553-559 [PMID: 28315280 DOI: 10.1055/s-0042-124363]
- 51 **Leong RW**, Ooi M, Corte C, Yau Y, Kermeen M, Katelaris PH, McDonald C, Ngu M. Full-Spectrum Endoscopy Improves Surveillance for Dysplasia in Patients With Inflammatory Bowel Diseases.

- Gastroenterology* 2017; **152**: 1337-1344.e3 [PMID: 28126349 DOI: 10.1053/j.gastro.2017.01.008]
- 52 **Vleugels JLA**, Rutter MD, Ragunath K, Rees CJ, Ponsioen CY, Lahiff C, Ket SN, Wanders LK, Samuel S, Butt F, Kuiper T, Travis SPL, D'Haens G, Wang LM, van Eeden S, East JE, Dekker E. Chromoendoscopy versus autofluorescence imaging for neoplasia detection in patients with longstanding ulcerative colitis (FIND-UC): An international, multicentre, randomised controlled trial. *Lancet Gastroenterol Hepatol* 2018; **3**: 305-316 [PMID: 29567006 DOI: 10.1016/S2468-1253(18)30055-4]
- 53 **Watanabe T**, Ajioka Y, Mitsuyama K, Watanabe K, Hanai H, Nakase H, Kunisaki R, Matsuda K, Iwakiri R, Hida N, Tanaka S, Takeuchi Y, Ohtsuka K, Murakami K, Kobayashi K, Iwao Y, Nagahori M, Iizuka B, Hata K, Igarashi M, Hirata I, Kudo SE, Matsumoto T, Ueno F, Watanabe G, Ikegami M, Ito Y, Oba K, Inoue E, Tomotsugu N, Takebayashi T, Sugihara K, Suzuki Y, Watanabe M, Hibi T. Comparison of Targeted vs Random Biopsies for Surveillance of Ulcerative Colitis-Associated Colorectal Cancer. *Gastroenterology* 2016; **151**: 1122-1130 [PMID: 27523980 DOI: 10.1053/j.gastro.2016.08.002]
- 54 **Leifeld L**, Rogler G, Stallmach A, Schmidt C, Zuber-Jerger I, Hartmann F, Plauth M, Drabik A, Hofstädter F, Dienes HP, Kruis W; Detect Dysplasia Study Group. White-Light or Narrow-Band Imaging Colonoscopy in Surveillance of Ulcerative Colitis: A Prospective Multicenter Study. *Clin Gastroenterol Hepatol* 2015; **13**: 1776-1781.e1 [PMID: 25952309 DOI: 10.1016/j.cgh.2015.04.172]
- 55 **Gasia MF**, Ghosh S, Panaccione R, Ferraz JG, Kaplan GG, Leung Y, Novak KL, Seow CH, Iacucci M. Targeted Biopsies Identify Larger Proportions of Patients With Colonic Neoplasia Undergoing High-Definition Colonoscopy, Dye Chromoendoscopy, or Electronic Virtual Chromoendoscopy. *Clin Gastroenterol Hepatol* 2016; **14**: 704-12.e4 [PMID: 26804384 DOI: 10.1016/j.cgh.2015.12.047]
- 56 **Shergill AK**, Farraye FA. Toward a consensus on endoscopic surveillance of patients with colonic inflammatory bowel disease. *Gastrointest Endosc Clin N Am* 2014; **24**: 469-481 [PMID: 24975537 DOI: 10.1016/j.giec.2014.03.006]
- 57 **Moussata D**, Allez M, Cazals-Hatem D, Treton X, Laharie D, Reimund JM, Bertheau P, Bourrille A, Lavergne-Slove A, Brixi H, Branche J, Gornet JM, Stefanescu C, Moreau J, Marteau P, Pelletier AL, Carbonnel F, Seksik P, Simon M, Flejou JF, Colombel JF, Charlois AL, Roblin X, Nancey S, Bouhnik Y, Berger F, Flourie B, the GETAID. Are random biopsies still useful for the detection of neoplasia in patients with IBD undergoing surveillance colonoscopy with chromoendoscopy? *Gut* 2018; **67**: 616-624 [PMID: 28115492 DOI: 10.1136/gutjnl-2016-311892]
- 58 **Shen B**, Kochhar G, Navaneethan U, Liu X, Farraye FA, Gonzalez-Lama Y, Bruining D, Pardi DS, Lukas M, Bortlik M, Wu K, Sood A, Schwartz DA, Sandborn WJ; Global Interventional Inflammatory Bowel Disease Group. Role of interventional inflammatory bowel disease in the era of biologic therapy: A position statement from the Global Interventional IBD Group. *Gastrointest Endosc* 2019; **89**: 215-237 [PMID: 30365985 DOI: 10.1016/j.gie.2018.09.045]
- 59 **Moss A**, Bourke MJ, Williams SJ, Hourigan LF, Brown G, Tam W, Singh R, Zanati S, Chen RY, Byth K. Endoscopic mucosal resection outcomes and prediction of submucosal cancer from advanced colonic mucosal neoplasia. *Gastroenterology* 2011; **140**: 1909-1918 [PMID: 21392504 DOI: 10.1053/j.gastro.2011.02.062]
- 60 **Hurlstone DP**, Sanders DS, Atkinson R, Hunter MD, McAlindon ME, Lobo AJ, Cross SS, Thomson M. Endoscopic mucosal resection for flat neoplasia in chronic ulcerative colitis: Can we change the endoscopic management paradigm? *Gut* 2007; **56**: 838-846 [PMID: 17135310 DOI: 10.1136/gut.2006.106294]
- 61 **Kinoshita S**, Uraoka T, Nishizawa T, Naganuma M, Iwao Y, Ochiai Y, Fujimoto A, Goto O, Shimoda M, Ogata H, Kanai T, Yahagi N. The role of colorectal endoscopic submucosal dissection in patients with ulcerative colitis. *Gastrointest Endosc* 2018; **87**: 1079-1084 [PMID: 29122603 DOI: 10.1016/j.gie.2017.10.035]
- 62 **Gulati S**, Emmanuel A, Burt M, Dubois P, Hayee B, Haji A. Outcomes of Endoscopic Resections of Large Laterally Spreading Colorectal Lesions in Inflammatory Bowel Disease: A Single United Kingdom Center Experience. *Inflamm Bowel Dis* 2018; **24**: 1196-1203 [PMID: 29668968 DOI: 10.1093/ibd/izx113]
- 63 **Kochhar G**, Steele S, Sanaka M, Gorgun E. Endoscopic Submucosal Dissection for Flat Colonic Polyps in Patients With Inflammatory Bowel Disease, A Single-Center Experience. *Inflamm Bowel Dis* 2018; **24**: e14-e15 [PMID: 29688475 DOI: 10.1093/ibd/izy101]
- 64 **Lahiff C**, Mun Wang L, Travis SPL, East JE. Diagnostic Yield of Dysplasia in Polyp-adjacent Biopsies for Patients with Inflammatory Bowel Disease: A Cross-sectional Study. *J Crohns Colitis* 2018; **12**: 670-676 [PMID: 29385427 DOI: 10.1093/ecco-jcc/jjy007]
- 65 **Ten Hove JR**, Mooiweer E, Dekker E, van der Meulen-de Jong AE, Offerhaus GJ, Ponsioen CY, Siersema PD, Oldenburg B. Low Rate of Dysplasia Detection in Mucosa Surrounding Dysplastic Lesions in Patients Undergoing Surveillance for Inflammatory Bowel Diseases. *Clin Gastroenterol Hepatol* 2017; **15**: 222-228.e2 [PMID: 27613257 DOI: 10.1016/j.cgh.2016.08.035]
- 66 **Odze RD**, Farraye FA, Hecht JL, Hornick JL. Long-term follow-up after polypectomy treatment for adenoma-like dysplastic lesions in ulcerative colitis. *Clin Gastroenterol Hepatol* 2004; **2**: 534-541 [PMID: 15224277 DOI: 10.1016/S1542-3565(04)00237-X]
- 67 **Vieth M**, Behrens H, Stolte M. Sporadic adenoma in ulcerative colitis: Endoscopic resection is an adequate treatment. *Gut* 2006; **55**: 1151-1155 [PMID: 16423892 DOI: 10.1136/gut.2005.075531]
- 68 **Thomas T**, Abrams KA, Robinson RJ, Mayberry JF. Meta-analysis: Cancer risk of low-grade dysplasia in chronic ulcerative colitis. *Aliment Pharmacol Ther* 2007; **25**: 657-668 [PMID: 17311598 DOI: 10.1111/j.1365-2036.2007.03241.x]
- 69 **Connell WR**, Lennard-Jones JE, Williams CB, Talbot IC, Price AB, Wilkinson KH. Factors affecting the outcome of endoscopic surveillance for cancer in ulcerative colitis. *Gastroenterology* 1994; **107**: 934-944 [PMID: 7926483 DOI: 10.1016/0016-5085(94)90216-X]
- 70 **Hata K**, Watanabe T, Kazama S, Suzuki K, Shinozaki M, Yokoyama T, Matsuda K, Muto T, Nagawa H. Earlier surveillance colonoscopy programme improves survival in patients with ulcerative colitis associated colorectal cancer: Results of a 23-year surveillance programme in the Japanese population. *Br J Cancer* 2003; **89**: 1232-1236 [PMID: 14520452 DOI: 10.1038/sj.bjc.6601247]
- 71 **Rutter MD**, Saunders BP, Wilkinson KH, Rumbles S, Schofield G, Kamm MA, Williams CB, Price AB, Talbot IC, Forbes A. Thirty-year analysis of a colonoscopic surveillance program for neoplasia in ulcerative colitis. *Gastroenterology* 2006; **130**: 1030-1038 [PMID: 16618396 DOI: 10.1053/j.gastro.2005.12.035]
- 72 **Odze RD**, Goldblum J, Noffsinger A, Alsaigh N, Rybicki LA, Fogt F. Interobserver variability in the diagnosis of ulcerative colitis-associated dysplasia by telepathology. *Mod Pathol* 2002; **15**: 379-386 [PMID: 11950911 DOI: 10.1038/modpathol.3880534]

- 73 **Navaneethan U**, Jegadeesan R, Gutierrez NG, Venkatesh PG, Hammel JP, Shen B, Kiran RP. Progression of low-grade dysplasia to advanced neoplasia based on the location and morphology of dysplasia in ulcerative colitis patients with extensive colitis under colonoscopic surveillance. *J Crohns Colitis* 2013; **7**: e684-e691 [PMID: [23916526](#) DOI: [10.1016/j.crohns.2013.06.006](#)]
- 74 **Derikx LA**, Kievit W, Drenth JP, de Jong DJ, Ponsioen CY, Oldenburg B, van der Meulen-de Jong AE, Dijkstra G, Grubben MJ, van Laarhoven CJ, Nagtegaal ID, Hoentjen F; Dutch Initiative on Crohn and Colitis. Prior colorectal neoplasia is associated with increased risk of ileoanal pouch neoplasia in patients with inflammatory bowel disease. *Gastroenterology* 2014; **146**: 119-28.e1 [PMID: [24076060](#) DOI: [10.1053/j.gastro.2013.09.047](#)]
- 75 **Liu ZX**, Kiran RP, Bennett AE, Ni RZ, Shen B. Diagnosis and management of dysplasia and cancer of the ileal pouch in patients with underlying inflammatory bowel disease. *Cancer* 2011; **117**: 3081-3092 [PMID: [21264836](#) DOI: [10.1002/cncr.25886](#)]
- 76 **Centre for Clinical Practice at NICE (UK)**. In: Colonoscopic Surveillance for Prevention of Colorectal Cancer in People with Ulcerative Colitis, Crohn's Disease or Adenomas. London: 2011 [PMID: [22259825](#)]



Published By Baishideng Publishing Group Inc
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: <http://www.f6publishing.com/helpdesk>
<http://www.wjgnet.com>

