Regence

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In Vivo Analysis of Colorectal Lesions

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IMPORTANT REMINDER

Medical Policies are developed to provide guidance for members and providers regarding coverage in accordance with contract terms. Benefit determinations are based in all cases on the applicable contract language. To the extent there may be any conflict between the Medical Policy and contract language, the contract language takes precedence.

PLEASE NOTE: Contracts exclude from coverage, among other things, services or procedures that are considered investigational or cosmetic. Providers may bill members for services or procedures that are considered investigational or cosmetic. Providers are encouraged to inform members before rendering such services that the members are likely to be financially responsible for the cost of these services.

DESCRIPTION

Several adjunct techniques of in vivo analysis of polyps are being researched for the purpose of improving the analysis of lesions and detection of changes in the colon. Use of these devices is proposed to increase the rate of polyp detection and/or to distinguish premalignant from benign lesions for removal.

MEDICAL POLICY CRITERIA

In vivo analysis of colorectal lesions, including but not limited to polyps, is considered **investigational**.

NOTE: A summary of the supporting rationale for the policy criteria is at the end of the policy.

CROSS REFERENCES

1. Confocal Laser Endomicroscopy, Medicine, Policy No. 151

BACKGROUND

During a colonoscopy or sigmoidoscopy as a screening test for colorectal cancer, the physician must often decide which polyp should be removed for histologic diagnosis. While

hyperplastic polyps are considered benign without malignant potential, adenomatous polyps are thought to represent one of the earliest stages in the progression to a malignancy. Identification of these premalignant lesions is considered one of the cornerstones of colorectal cancer prevention. The physician must thus balance the time and potential morbidity of removing all polyps, many of which will be benign, versus removal of those polyps most likely to be adenomatous.

Several techniques of in vivo analysis of polyps are being researched for the purpose of improving the analysis of lesions and detection of changes in walls of colon. These methods are intended to be used as an adjunct to colonoscopy. Some of these methods include autofluorescence, narrow band imaging (NBI), multi-band imaging, chromoendoscopy, third eye retroscope and fiberoptic analysis. It is proposed that these technologies may allow for in vivo analysis of the polyps, possibly avoiding unnecessary biopsies and increasing detection of difficult to visualize lesions (e.g., flat lesions).

The first system developed was based on the observation that benign and malignant tissues emit different patterns and wavelengths of fluorescence after exposure to a laser light. This system consists of an optical fiber, emitting a laser that is directed against three different regions of the same polyp. The subsequent florescent signal is collected, measured, and analyzed by a proprietary software system, which classifies a polyp as "suspicious" (i.e., adenomatous) or "not suspicious" (i.e., hyperplastic). There are several different types of spectroscopy-based in vivo techniques that rely on autofluorescence, emitting light at different frequencies in an attempt to distinguish between hyperplastic and adenomatous lesions.

Narrow band imaging (NBI) is another new technique that allows visualization of the mucosal surface and capillary vessels and thus may assist in the differentiation of abnormal from normal mucosa during colonoscopy. Two NBI systems are available. The NBI color chip system is used in the United States; in this system a single filter with a two-band pass characteristic is used to generate central wavelengths at 415 nm (blue) and 540 nm (green and red). The NBI red-green-blue sequential illumination system uses narrow spectra of red, green, and blue light and a video endoscopic system with a frame sequential lighting method. The light source unit consists of a xenon lamp and a rotation disk with three optical filters. The rotation disk and monochrome charge-coupled device are synchronized and sequentially generate images in three optical filter bands. By use of all three band images, a single color endoscopic image is synthesized by the video processor. NBI has limited penetration into the mucosal surface and has enhanced visualization of capillary vessels and their fine structure on the surface layer of colonic tissue.

Chromoendoscopy, also known as chromoscopy and chromocolonoscopy, refers to the application of topical stains or dyes during endoscopy to enhance tissue differentiation or characterization and facilitate identification of mucosal abnormalities. Chromoendoscopy may be particularly useful for detecting flat or depressed lesions. Standard colonoscopy uses white light to view the colon. In chromoendoscopy, stains are applied, resulting in color highlighting of areas of surface morphology of epithelial tissue. The dyes or stains are applied via a spray catheter that is inserted down the working channel of the endoscope. Chromoendoscopy can be used in the whole colon (pancolonic chromoendoscopy) on an untargeted basis or can be directed to a specific lesion or lesions (targeted chromoendoscopy). Chromoendoscopy differs from endoscopic tattooing in that the former uses transient stains, whereas tattooing involves the use of a long-lasting pigment for future localization of lesions.

Virtual chromoendoscopy (also called electronic chromoendoscopy) involves imaging enhancements with endoscopy systems that could be an alternative to dye spraying. One system is the Fujinon® Intelligent Color Enhancement (FICE®) feature (Fujinon Inc.). This technology uses postprocessing computer algorithms to modify the light reflected from the mucosa from conventional white light to various other wavelengths.

REGULATORY STATUS

Auto-fluorescence

In 2000, the Optical Biopsy™ System (SpectraScience™, Inc.) was approved by the Food and Drug Administration (FDA).The FDA-labeled indication for the Optical Biopsy™ System reads as follows:[1]

> "The SpectraScience™ Optical Biopsy™ System is indicated for use as an adjunct to lower gastrointestinal endoscopy. The device is intended for the evaluation of polyps less than 1 cm in diameter that the physician has not already elected to remove. The device is only to be used in deciding whether such polyps should be removed (which includes submission for histological examination)."

NBI

NBI received FDA clearance through the 510K process in 2005. This clearance (K051645) added NBI with the EVIS EXERA 160A System (Olympus Medical Systems Corp.) to existing endoscopic equipment. FDA indications are for endoscopic diagnosis, treatment, and video observation. In addition, in 2012, the EVIS EXERA III System, which has dual focus (DF) capabilities received FDA approval.[2]

Chromoendoscopy

In August of 2016, the Fuse Colonoscope with FuseBox Processor was cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process.[3] This system is indicated for use within the lower digestive tract for adult patients. This system includes Lumos and is intended to be used as an optional adjunct following white light endoscopy and is not intended to replace histopathological sampling as a means of diagnosis.

In August 2014, the Fujifilm EPX-4440HD Digital Video Processor with FICE and Light Source was cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process. In October of 2015, the PMA was extended to include and additional digital video processor, EPX-4440. FDA documents state that FICE can be used to supplement white-light endoscopy but is not intended to replace histopathologic sampling as a means of diagnosis. In January 2017, the Fujifilm Processor VP-7000 and Light source BL-7000 was cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process with the EPX-4440HD as a predicate device.[4] FDA documents state “BLI (Blue Light Imaging), LCI (Linked Color Imaging) and FICE (Flexible spectral-Imaging Color Enhancement) are adjunctive tools for gastrointestinal endoscopic examination which can be used to supplement Fujifilm white light endoscopy. BLI, LCI and FICE are not intended to replace histopathological sampling as a means of diagnosis.”

In November, 2019, the i-scan™ (Pentax), used for virtual chromoendoscopy, was cleared for marketing by FDA through the 510(k) process.[5] This is a digital image enhancement technology and is part of the Pentax EPK-i5010 and EPK-i7010 Video Processors. The i-scan

has several modes that digitally enhance images in real–time during endoscopy. FDA documents state that i-scan is intended as an adjunct following white-light endoscopy and is not intended to replace histopathologic analysis.

No dye or stain product has been specifically approved by FDA for use in chromoendoscopy.

EVIDENCE SUMMARY

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition. The comparator for the techniques discussed in this review is standard definition white light endoscopy (SD-WLE) or high-definition WLE (HD-WLE). The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

MULTIPLE TECHNIQUES

Systematic Reviews

Al-Mansour (2021) reported about the safety and accuracy of Confocal laser endomicroscopy (CLE) that allows real time *in vivo* histological examination of mucosal surfaces in the gastrointestinal tract.[6] The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) Technology and Value Assessment Committee (TAVAC) performed a PubMed/Medline database search of clinical studies involving CLE in May of 2018. Case reports and small case series were excluded. It was concluded that the technology offers an excellent safety profile with rare adverse events related to the use of fluorescent agents. It has been shown to increase the detection of dysplastic Barrett's esophagus, gastric intraepithelial neoplasia/early gastric cancer, and dysplasia associated with inflammatory bowel disease when compared to standard screening protocols.

El-Dallal (2020) reported results of a meta-analysis comparing virtual chromoendoscopy, dye-spraying chromoendoscopy, and HD-WLE.[7] Eleven randomized controlled trials met inclusion criteria. The quality of evidence was moderate in the HD-WLE studies and low to moderate in the DCE studies. In the per-patient analysis of the 1,328 patients, there were no statistically significant differences between virtual chromoendoscopy and dye-spraying chromoendoscopy (risk ratio [RR] 0.77; 95% CI 0.55 to 1.08) or between virtual chromoendoscopy and HD-WLE (RR 0.72; 95% CI 0.45 to 1.15). In the per-dysplasia analysis, there were no statistically significant differences between virtual chromoendoscopy and dye-spraying chromoendoscopy (RR 0.72; 95% CI 0.47 to 1.11), but virtual chromoendoscopy was inferior to HD-WLE (RR 0.62; 95% CI 0.44 to 0.88).

Facciorusso (2019) performed a systematic review of RCTs comparing the efficacy of a variety of devices for the detection of adenomas.[8] A total of 74 two-arm trials assessing add-on devices, enhanced imaging techniques, new scopes, and low-cost optimization of existing resources were included. Moderate increases in adenoma detection rate were found for low-cost optimization of existing resources (odds ratio [OR], 1.29; 95% confidence interval [CI] 1.17 to 1.43), enhanced imaging techniques (OR,1.21; 95% CI 1.09 to 1.35), and add-on devices

(OR,1.18; 95% CI 1.07 to 1.29). Of those, no specific technology was superior to others for detection of advanced adenomas, polyp detection rate, or mean number of adenomas per patient, indicating that low-cost optimization of existing resources was as effective as enhanced endoscopic imaging.

Bessissow (2018) performed a systematic review and meta-analysis of RCTs that compared dysplasia detection techniques in patients with ulcerative colitis.[9] Eight parallel group RCTs including 924 patients met inclusion criteria. Patients were adults with long-standing ulcerative colitis (UC) undergoing surveillance colonoscopy with SD-WLE, HD-WLE, narrow band imaging (NBI), or dye-based chromoendoscopy. The evidence was rated as low- to very low-quality using GRADE. The meta-analysis supported chromoendoscopy over SD-WLE (odds ratio [OR], 2.37; 95% credible interval [CrI], 0.81 to 6.94) for any dysplasia detection with low-quality evidence, whereas very low-quality evidence supports using HD-WLE or NBI over SD-WLE (HD-WLE [vs SD-WLE]: OR, 1.21; 95% CrI, 0.30 to 4.85; NBI: OR, 1.68; 95% CrI, 0.54 to 5.22).

Lord (2018) performed a systematic review of the diagnostic accuracy of several techniques of colonic lesion characterization.[10] A total of 22 studies assessing techniques for in-vivo optical characterization of lesions in patients with colonic IBD during colonoscopy, including 1,491 patients, met inclusion criteria. Techniques examined were virtual chromoendoscopy (VCE), dye-based chromoendoscopy (DBC), magnification endoscopy and confocal laser endomicroscopy (CLE). The quality of included studies was rated and there was mixed quality for all three domains of risk of bias (patient selection, index test, and reference standard). Pooled sensitivities of CLE, magnification endoscopy, DBC, and VCE were 91% (95% CI 94 to 98%), 90% (95% CI 77 to 96%), 67% (95% CI 44 to 84%) and 86% (95% CI 62 to 95%), respectively. Pooled specificities of magnification endoscopy, VCE, and DBC were 87% (95% CI 81 to 91%), 87% (95% CI 72 to 95%), and 86% (95% CI 72 to 94%), respectively, and the area under the SROC curve for CLE was 0.98 (95% CI 0.97-0.99). The authors concluded that real-time CLE is a highly accurate technology while acknowledging that this study is limited by the fact that most CLE studies were performed by single expert users within tertiary centers.

In 2013, Wanders assessed the sensitivity, specificity, and real-time negative predictive value or NBI, image-enhanced endoscopy (i-scan), Fujinon intelligent chromoendoscopy (FICE), CLE, and autofluorescence imaging for differentiating neoplastic from non-neoplastic colon lesions.[11] A total of 91 studies were included in the analysis (NBI=56, i-scan=10, FICE=14, CLE=11 and autofluorescence imaging=11). The authors reported the following for each modality:

- “For NBI, overall sensitivity was 91.0% (95% CI 88.6 to 93.0), specificity 85.6% (81.3 to 89.0), and real-time negative predictive value 82.5% (75.4 to 87.9).
- For i-scan, overall sensitivity was 89.3% (83.3 to 93.3), specificity 88.2% (80.3 to 93.2), and real-time negative predictive value 86.5% (78.0 to 92.1).
- For FICE, overall sensitivity was 91.8% (87.1 to 94.9), specificity 83.5% (77.2 to 88.3), and real-time negative predictive value 83.7% (77.5 to 88.4).
- For autofluorescence imaging, overall sensitivity was 86.7% (79.5 to 91.6), specificity 65.9% (50.9 to 78.2), and real-time negative predictive value 81.5% (54.0 to 94.3).
- For CLE, overall sensitivity was 93.3% (88.4 to 96.2), specificity 89.9% (81.8 to 94.6), and real-time negative predictive value 94.8% (86.6 to 98.1).”

The authors did not recommend autofluorescence imaging as a reliable optical diagnostic

option due to low specificity rates. This study did not assess whether any of these optical imaging modalities improved patient management or overall health outcomes.

Randomized Controlled Trials

Iacucci (2018) performed a randomized non-inferiority trial to determine detection rates of neoplastic lesions in IBD patients with longstanding colitis.[12] A total of 270 patients with inactive disease were enrolled and divided evenly to be assessed by high definition (HD), dye spraying chromoendoscopy (DCE), or VCE using i-scan image enhanced colonoscopy. Neoplastic lesions were classified by the Paris classification and Kudo pit pattern followed by histological classification using the Vienna classification. VCE was determined to have non-inferior neoplastic lesion detection rates compared to DCE. HD rates of detection of all neoplastic lesions were non-inferior to DCE and VCE. Kudo pit pattern and location at the right colon were found to predict neoplastic lesions. The authors concluded that HD-WLE alone was sufficient for detection of dysplasia, adenocarcinoma, or all neoplastic lesions.

AUTO-FLUORESCENCE IMAGING

Nonrandomized Studies

In 2013, Inomata conducted a prospective nonrandomized trial to evaluate colorectal lesions using a new auto-fluorescence imaging (AFI) system.[13] A total of 88 patients with 163 lesions greater than 5 mm were evaluated using the novel AFI system which assessed the green/red (G/R) ratio for each lesion using a computer-assisted color analysis system that permits real-time color analysis during endoscopic procedures. Authors reported significant differences in the G/R ratios of hyperplastic polyps, adenoma/intramucosal cancer/submucosal (SM) superficial cancer, and SM deep cancer ($p<0.0001$). The mean ± SD G/R ratios were 0.984 ± 0.118 in hyperplastic polyps and 0.827 ± 0.081 in neoplastic lesions. When a cut-off value of >0.89 was applied to non-neoplastic lesions, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were 83.9%, 82.6%, 53.1%, 95.6% and 82.8%, respectively. When a cut-off value of <0.77 was applied to identify SM deep cancers, the sensitivity, specificity, PPV, NPV, and accuracy were 80.0%, 84.4%, 29.6%, 98.1% and 84.1%, respectively. Additional studies are needed to validate these cut-off values and to assess the impact of AFI upon improved health outcomes.

The FDA approval for the SpectraScience™ Optical Biopsy™ System was based on a prospective, nonrandomized phase II study involving 101 subjects from five sites. The data from this trial have not been published in a peer-reviewed journal but are available as an FDA summary of safety and effectiveness.[1] Patients who participated in the study had undergone a prior lower GI endoscopic procedure with at least one polyp identified. They were then referred for an additional colonoscopy exam, in which fiberoptic analysis of the polyps was performed. At the time of the colonoscopy, the physicians documented whether or not the polyp was considered hyperplastic or adenomatous, and whether or not they would remove the polyp. The fiberoptic probe was then applied to three different portions of the polyp and a segment of normal adjacent mucosa. The physician did not know the results of the analysis and thus the test did not affect patient treatment. The effectiveness of the analysis was then calculated as its ability to correctly identify adenomatous polyps (sensitivity) and to correctly identify hyperplastic polyps (specificity), either alone or in conjunction with the physician assessment. The sensitivity and specificity of the physician assessment alone was 82.7% and 50%, respectively, compared to a combined sensitivity and specificity of 96.3% and 33%, respectively. In other words, fiberoptic analysis identified additional adenomatous polyps that

the physician had classified as hyperplastic and presumably would not have removed based on visual assessment alone. This increase in sensitivity comes at the price of a decrease in specificity, as more hyperplastic polyps will undergo biopsy. However, according to the FDA, the risk of taking biopsies of additional hyperplastic polyps is minimal.

The clinical significance of these results and their effect on patient management is difficult to interpret from the data presented. It is not clear how the physician decided to select additional polyps for fiberoptic analysis (it is not entirely clear whether all polyps were analyzed and then underwent biopsy), or whether the same results could be obtained by simply randomly taking a biopsy of a subset of polyps that were considered hyperplastic on visual assessment. While adenomatous polyps are considered premalignant lesions, the evolution to cancer is a slow process requiring seven to eight years, and thus the immediate removal of all adenomatous polyps is not required. In addition, the finding of an adenomatous polyp serves as a marker that the patient should undergo more frequent endoscopic exams. It is well known that the current practice of visual inspection of polyps will certainly miss some adenomatous polyps, but this lack of sensitivity is considered acceptable if at least one adenomatous polyp is identified and the patient undergoes more frequent screening.

Few studies have been published on the SpectraScience™ Optical Biopsy™ System since 2002. A feasibility study of fiberoptic analysis of normal, adenomatous, and cancerous tissue in 11 patients was published by Mayinger in 2003.[14] No additional literature on the Optical Biopsy™ System was found, but a report in 2006 detailed the results of spectral scattering to different colonic lesions in a small series of 45 patients.[15]

NARROW BAND IMAGING (NBI)

The following evidence review for the diagnostic utility of NBI will focus on RCTs comparing NBI with white light and standard colonoscopy techniques.

Systematic Reviews

Feuerstein (2019) performed a systematic review and meta-analysis of RCTs and non-RCTs that assessed the efficacy of NBI versus white light endoscopy.[16] Six RCTs and four non-RCTs met inclusion criteria. The reported detection rates were 17% and 11%, respectively, for chromoendoscopy and white light endoscopy, respectively (relative risk 1.50; 95% CI, 1.08 to 2.10). The quality of evidence from RCTs was moderate. In data from non-RCTs, chromoendoscopy was more effective than white light endoscopy (16% versus 6%; RR, 3.41; 95% CI 2.13 to 5.47). The quality of evidence from non-RCTs was very low.

Atkinson (2019) performed a systematic review and meta-analysis of RCTs that assessed the adenoma detection rate in NBI versus white light endoscopy.[17] Studies of patients with inflammatory bowel disease or with familial or genetic syndromes were excluded. A total of 11 trials met inclusion criteria and data from 4491 patients were analyzed. A risk of bias assessment was performed, and little evidence of publication bias was found. The detection rate was similar overall, with an unadjusted OR for detection of adenoma by white light endoscopy vs NBI of 1.14 (95% CI 1.01 to 1.29; p=0.04). However, in cases when bowel preparation was considered best, NBI outperformed WLE (adequate preparation OR, 1.07, 95% CI 0.92 to 1.24, p=0.38; vs best preparation OR, 1.30 95% CI 1.04 to 1.62, p=0.02). Additionally, second-generation, but not first-generation, NBI had a better detection rate than white light endoscopy (second-generation NBI OR, 1.28; 95% CI 1.05 to 1.56, p=0.02).

Sabbagh (2011) conducted a meta-analysis of studies (regardless of indication) evaluating NBI compared to colonoscopy and did not find any significant differences in the mean number of polyps (five RCT, 2479 participants), the mean number of adenomas (eight RCTs, 3517 participants), and the rate of patients with at least one adenoma (eight RCTs, 3512 participants).[18] However, individual studies included in the analysis were noted to have heterogeneous populations and indications, as well as diverse findings. Overall, the authors concluded that NBI did not improve detection of colorectal polyps when compared with conventional colonoscopy.

Additional reviews assessing the ability of NBI to differentiate between neoplastic and non-neoplastic polyps have been published; however, these studies are limited due to their inclusion of nonrandomized studies and lack of analysis regarding the impact of NBI upon patient management of overall health outcomes.[19]

Randomized Controlled Trials

Data from several randomized trials of NBI versus white-light colonoscopy (WLE) failed to show any advantage in total detection rate for NBI.[18, 20-24] Published randomized trials differ from the conventional approach to the assessment of diagnostic tests. In these trials patients were randomized to one test or the other (i.e., they received only one test). In general, when comparing diagnostic tests, each patient would receive both tests and the test results would be compared, which more recent trials have done.

Jung (2021) reported results of a randomized study comparing NBI and WLE to detect remnant tissue following removal of suspicious sessile-serrated adenoma.[25] A total of 145 lesions were removed from 138 patients. There were no statistically significant differences in histologic diagnostic rate (89.9% (62/69) vs. 85.5% (65/76); p>0.05), detection of remnant tissue (12.9% (8/62) vs. 15.4% (10/65); p>0.05), the proportion of SSA in remnant tissue (11.3% (7/62) vs. 12.3% (8/65); p>0.05), or the proportion of incomplete resection (6.5 (4/62) vs. 10.8 (7/65); p>0.05) between the NBI and WLE inspection groups, respectively.

Riu Pons (2020) conducted a randomized cross-over trial to compare NBI with HD-WLE in 41 patients with prior detection of at least one serrated polyp ≥10 mm or ≥ 3 serrated polyps larger than 5 mm, both proximal to the sigmoid colon.[26] All patients received tandem same-day colonoscopies with both techniques, performed by one of five experienced endoscopists, with the order being randomized 1:1 to NBI-HD-WLE or HD-WLE-NBI. All tandem colonoscopies were performed by the same endoscopist. No differences were reported in serrated lesion detection rate (47.4% for NBI versus 51.9% for HD-WLE; OR 0.84, 95% CI 0.37 to 1.91) or polyp miss rate (21.3% for NBI versus 26.1% for HD-WLE; OR 0.77, 95% CI 0.43 to 1.38).

Kim (2019) randomized 117 patients to NBI using the new 290 system (290-NBI) or HDWL colonoscopy.[27] All patients were then inspected with the technology not used initially, such that each patient was inspected with both NBI and HDWL with the order randomized. While the adenoma or polyp detection rates were not different between the two groups (polyp miss rates for 290-NBI and HDWL were 20.6% and 33.9%, respectively; p=0.068), the non-adenomatous polyp miss rate for 290-NBI was significantly lower than that of HDWL (11.5% vs. 52.2%, p=0.002). In addition, for polyps on the left side of the colon, flat-type polyps, and non-adenomatous polyps miss rates were significantly lower for 290-NBI than HDWL.

In a 2017 RCT, Min reported on 152 patients (142 were included in the analysis) that underwent crossover colonoscopies with white light endoscopy and linked color imaging (LCI), which uses narrow-band short-wavelength light and WL, randomized for order.[28] The sensitivities in the white light and LCI groups were significantly different, at 73% and 91%, respectively. Negative predictive value was not reported.

In a 2016 RCT, Klare randomized 380 patients to the NBI arm or the high-definition white light arm.[29] Accuracy was 73.7% and 79.2%, sensitivity was 82.4% and 79.8%, and negative predictive value was 75.5% and 73.4% in the NBI and white light arms, respectively. These values were not significantly different between arms.

In a randomized controlled trial reported by Gross (2011), 100 patients undergoing routine screening and surveillance were randomized to receive tandem colonoscopies with standard definition white light (SDWL) and image-enhanced (HD-NBI) colonoscopy.[30] The main outcome measurement was the per-polyp false-negative ("miss") rate. Secondary outcomes were adenoma miss rate, and per-patient polyp and adenoma miss rates. Polyp and adenoma miss rates for SDWL colonoscopy were 57 % (60/105) and 49 % (19/39); those for image-enhanced colonoscopy were 31 % (22/72) and 27 % (9/33) (p=0.005 and p=0.036 for polyps and adenomas, respectively). Image-enhanced and SDWL approaches had similar per-patient miss rates for polyps (6/35 vs. 9/32, p=0.27) and adenomas (4/22 vs. 8/20, p=0.11). The authors concluded that utilization of multiple recent improvements in image-enhanced colonoscopy was associated with a reduced miss rate for all polyps and for adenomatous polyps. It is not known which individual feature or combination of image-enhancement features led to the improvement.

Kakol (2013) evaluated the usefulness of NBI for detection of missed polyps after colonoscopy comparing white light (WL) to NBI.[31] After initial colonoscopy 253 patients were randomized to a second colonoscopy with either NBI or WL. Authors found no significant difference between missed polyps or adenomas between groups.

In 2014, Wallace published results an RCT which compared NBI to standard colonoscopy and found no differences between groups.[32] A total of 522 patients were randomized and 927 total polyps were analyzed. No differences were observed in adenoma detection rate or diagnostic accuracy, regardless of polyp size.

Several randomized trials addressed both total detection rate and differentiation of neoplastic from nonneoplastic lesions.

Pohl conducted a randomized multicenter trial in 2009 of virtual chromoendoscopy with the “Fujinon intelligent colour enhancement” system (FICE or NBI) versus standard colonoscopy with targeted indigocarmine chromoscopy.[33] This German trial included 764 patients in the final analysis and reported that FICE/NBI was not superior to control for overall adenoma detection rates; it was comparable on the differentiation of neoplastic and non-neoplastic lesions. The sensitivity of FICE/NBI was 92.7% versus 90.4% for the control.

Additional RCTs were identified[34-36]; however, these studies contained several methodological flaws in that they only reported on the accuracy of the NBI system in the in vivo evaluation of colonic polyps. In addition, none of the studies evaluated the impact of this technology on outcomes including whether or not there would be an improvement in the selection of polyps for removal during colonoscopy. Furthermore, subsequent RCTs[37] demonstrate no differences in polyp detection rate of NBI compared to WL.

CHROMOENDOSCOPY

Systematic Reviews

Antonelli (2022) conducted a meta-analysis to evaluate the efficacy of dye-based chromoendoscopy in detecting colorectal neoplasia.[38] The analysis included 10 RCTs of individuals at average or increased risk of colorectal cancer (CC) undergoing conventional (standard or high-definition white light) colonoscopy, or colonoscopy with dye-based chromoendoscopy. Patients with IBD or genetic/familial syndromes were excluded. In patients at average or increased risk of CC, the meta-analysis showed that dye-based chromoendoscopy increased adenoma detection rate by 20%, and adenomas per colonoscopy by 50%, corresponding to a number needed to treat of 12 to detect 1 additional patient with adenoma. Limitations of the meta-analysis included unclear indication of colonoscopy in the studies and some heterogeneity in mean adenomas per patient.

Azizi (2018) performed a systematic review comparing white light endoscopy and chromoendoscopy for identifying dysplastic or cancerous lesions in patients with ulcerative colitis without primary sclerosing (PSC) or Crohn's disease (CD).[39] Studies were included if they reported on colonoscopy detection rates of dysplasia and cancers in UC without involvement of PSC or CD. Ten studies met inclusion criteria; most were of moderate quality. Publication bias was not assessed due to the low number of publications per incidence outcome. A meta-analysis of the five studies reporting overall pick-up rate of dysplastic/cancerous lesions on WLE random biopsies calculated showed a pooled rate of 5.6%. Only one study reported on the use of chromoendoscopy for ulcerative colitis patients without PSC. The reported pick-up rate of dysplastic lesions in this study was 7%.

In 2016, Brown updated their 2010 Cochrane review that compared chromoendoscopy and conventional colonoscopy for the detection of colorectal lesions in individuals at increased risk of colorectal neoplasia due to family history, previous polyp detection, or previous CRC resection.[40, 41] The review excluded studies of individuals with IBD or a known polyposis syndrome. Seven RCTs (2,727 participants) were included, five of which were used for a meta-analysis. All of these studies were published prior to 2012. The review found that chromoscopy was likely to yield more people with at least one neoplastic lesion (odds ratio (OR) 1.53, 95% CI 1.31 to 1.79; seven trials; 2,727 participants), and significantly more people with three or more neoplastic lesions were also detected, but only when studies that used high-definition colonoscopy in the control group were excluded (OR 4.63, 95% CI 1.99 to 10.80; two trials; 519 participants). None of the included studies reported any adverse events related to the use of the contrast dye. However, all the trials had some methodological drawbacks, and all were graded as low quality. In addition, some of the included studies were underpowered and significant heterogeneity was present between the included studies (variability of the colonoscopes used in the studies and differences in dye-spraying technique). There are also differences in the study inclusion criteria between the included studies).

Randomized Controlled Trials

The following randomized controlled trials were not included in the above systematic reviews.

Paiva (2023) compared chromoendoscopy to standard colonoscopy during a second sequential colonoscopy in 203 patients.[42] Both groups had routine colonoscopy and were then randomized to have either second procedure with chromoendoscopy or second procedure without chromoendoscopy. The most common reason for colonoscopy was screening (43.8%)

and the average age of subjects was 59.3 years. Prior to randomization, the difference between the groups in the number of patients who had polyps detected at first routine colonoscopy approached statistical significance (p=0.052); however, the difference in the number of polyps found at first procedure was not statistically significant (p=0.097). The second procedure revealed new polyps in both groups; and the chromoendoscopy group had more polyps than the standard colonoscopy group (35/102 vs. 14/1011; p=0.001). No high-grade adenomas or malignancy was found in either group at second colonoscopy. The rates of hyperplastic polyps and low-grade adenomas found in the second procedure were similar (p=0.294). While the study found chromoendoscopy led to the detection of more polyps, chromoendoscopy did not lead to a higher rate of clinically relevant polyp detection than conventional colonoscopy.

Wan (2021) conducted a prospective, multicenter randomized controlled study on patients with longstanding (at least six years) ulcerative colitis.[43] The study compared chromoendoscopy with targeted biopsies to white-light endoscopy with targeted biopsies and random biopsies. In the full-analysis data set, a total of 122 patients with 447 colonoscopies were analyzed, and the randomized groups were as follows: chromoendoscopy (n=39), white-light endoscopy-targeted (n=43), and white-light endoscopy-random (n=40). The primary outcome of the study was the number of colonoscopies that diagnosed dysplasia in each group. The median follow-up period during the study was 55 months; white-light endoscopy-random and chromoendoscopy treated patients had more colonoscopies that diagnosed dysplasia than white-light endoscopy-targeted treated patients (8.0% vs. 1.9%, p=.013; 9.3% vs. 1.9%, p=0.004, respectively). There was no significant difference found between the white-light endoscopy-random and chromoendoscopy groups. In a sub-group analysis in the second half of the follow-up period (37 to 69 months), chromoendoscopy had more colonoscopies that diagnosed dysplasia than white-light endoscopy-targeted (13.3% vs. 1.6%, p=0.015) and had results that indicated a trend for increasing dysplasia detection rates compared to white-light endoscopy-random (13.3% vs. 4.9%, p=0.107).

Alexandersson (2020) conducted a single-center, prospective study on 305 patients with longstanding (at least eight years) ulcerative colitis or Crohn colitis.[44] The study compared high-definition chromoendoscopy with high-definition white-light endoscopy. Patients were randomized into each group: chromoendoscopy (n=152) and white-light endoscopy (n=153). The primary outcome was the number of patients with dysplastic lesions. Dysplastic lesions were detected in 17 patients in the chromoendoscopy group (11%) and in seven patients in the white-light endoscopy group (5%), which was statistically significant (p=0.032). The total number of macroscopic lesions detected in the chromoendoscopy group versus the white-light endoscopy group (n= 89 vs. 41, respectively) was statistically significant (p<0.001), and the total number of macroscopic lesions containing dysplasia was higher in the chromoendoscopy group (n=24; p=0.029). The study found that chromoendoscopy was superior to white-light endoscopy in the detection of dysplastic lesions during colonoscopy; however, the study was limited to a single-center institution in Sweden and the expertise of the endoscopists was not detailed.

Yang (2019) performed a randomized controlled trial comparing HD-WLE with random biopsy versus high-definition chromoendoscopy with targeted biopsy in 210 patients with long-standing ulcerative colitis.[45] The difference in detection rates of colitis-associated dysplasia were not statistically significant between groups (20.6% for chromoendoscopy vs. 12.0% for HD-WLE; p=0.093). The median length of colonoscopy withdrawal was not significantly different between groups (17.6 vs 16.5 minutes; p=0.212) but the difference in total number of

biopsies was statistically significant, with 34 in the HD-WLE group and nine in the chromoendoscopy group (p<0.001).

Haanstra (2019) reported results of a multicenter RCT of patients with Lynch syndrome who were undergoing regular surveillance by colonoscopy.[46] A total of 246 patients were randomly assigned (1:1) to conventional WLE (n=123) or colonoscopy with CE in the proximal colon (n=123). Patients were stratified for previous colorectal adenomas and enrolling center. The primary outcome was the proportion of patients with the detection of at least one neoplastic lesion at baseline and after two years. Detection rates were not significantly different between groups at either baseline (27% for WLE versus 30% for CE; OR, 1.23; 95% CI 0.69 to 2.2; p=0.56) or two years (26% for the original WLE group versus 28% for the CE group (OR, 1.1; p=0.81).

Rondonotti (2019) compared blue-light imaging (BLI) chromoendoscopy with HDWL endoscopy for the characterization of polyps in patients undergoing colonoscopy.[47] A total of 358 consecutive patients undergoing outpatient colonoscopy who had at least one polyp less than 10mm were randomized to BLI or HDWL for polyp characterization. The number of polyps characterized with high confidence was not significantly different between groups (p=0.887), though the overall accuracy was, in favor of BLI (92% versus 84%, p=0.011).

Vleugels (2018) randomized patients undergoing dysplasia surveillance for longstanding ulcerative colitis at five centers in the Netherlands and the UK to receive autofluorescence imaging or chromoendoscopy.[48] Patients were eligible if they were age 18 years or older and were undergoing dysplasia surveillance after a diagnosis of extensive colitis at least eight years before the study start or left-sided colitis at least 15 years before the study start. Each group contained 105 patients. Primary outcomes were the proportion of patients in whom at least one dysplastic lesion was detected and the mean number of dysplastic lesions per patient. Dysplasia was detected in 12% and 19% of patients in the autofluorescence and chromoendoscopy groups, respectively. The mean number of detected dysplastic lesions per patient was 0.13 (SD 0.37) and 0.37 (SD 1.02) for autofluorescence and chromoendoscopy, respectively. Two and three adverse events were reported in the autofluorescence and chromoendoscopy groups, respectively. Autofluorescence imaging did not meet criteria for proceeding to a large non-inferiority trial.

VIRTUAL CHROMOENDOSCOPY

Systematic Reviews

Aziz (2019) performed a systematic review of RCTs comparing “distal attachments” (endocap, endocuff, and endoring) or “electronic chromoendoscopy” (narrow-band imaging, iScan, blue-light imaging, autofluorescence imaging, and linked-color imaging) with high definition white light endoscopy for the detection of serrated adenomas.[49] A total of 17 studies including 13,631 patients met inclusion criteria. There was no statistically significant improvement in serrated adenoma detection rate identified using distal attachments (RR 1.21; p=0.45) or electronic chromoendoscopy (RR 1.29; p=0.09).

A meta-analysis by Omata published in 2014 compared the rate of polyp detection by virtual chromoendoscopy (i.e., FICE or i-scan) with white-light colonoscopy.[50] The review included patients of all risk levels and was limited to RCTs. Five trials on FICE/i-scan met eligibility criteria and the analysis did not find a significantly higher detection rate with virtual chromoendoscopy. The pooled relative risk of adenoma/neoplasia detected by virtual

chromoendoscopy versus conventional chromoendoscopy was 1.09 (95% CI 0.97 to 1.23; p>0.05).

Randomized Controlled Trials

Kandiah (2021) published a multicenter RCT comparing the performance of high-definition white light versus high-definition virtual chromoendoscopy in patients in the United Kingdom with longstanding (at least 8 years) ulcerative or Crohn colitis.[51] Patients were randomized, prior to starting surveillance colonoscopy, to either white light (n=92) or virtual chromoendoscopy (n=92) for a total of 184 patients included in the final analysis. The primary outcome was the difference in neoplasia detection rate between the two arms. Twenty-five neoplastic lesions were found in 14 patients in the virtual chromoendoscopy arm; 27 lesions were found in 22 patients in the white light arm. Compared to the virtual chromoendoscopy arm, neoplasia detection rate was higher in the white light arm (23.4% vs. 14.9%), but this was not statistically significant (p=0.14). The mean number of biopsies taken per patient was 35.9 in each arm of the study, and the difference in the mean number of neoplasia per patient was not statistically significant between the two arms (p=0.75).

Kidambi (2018) randomized 740 patients undergoing screening and surveillance for colorectal neoplasia to receive colonoscopies with i-scan or with standard high-definition white-light.[52] Endoscopists were permitted to switch between i-scan and high-definition white-light imaging to confirm polyps. Polyps were collected and analyzed by histology. The primary outcome was adenoma detection rate (ADR, proportion of subjects with at least one adenoma of any size). Intention to treat and per-protocol analyses were performed. ADR was significantly higher in the i-scan group for both the intent to treat and per-protocol analyses, with values of 47.2% and 47.6% in the i-scan group and 37.7% and 37.2% in the standard group, respectively. However, there was inconsistency across endoscopists. Secondary analyses showed that increased ADR was associated with improved detection of diminutive flat adenomas in the right colon. The groups had significantly different rates of neoplasia detection (i-scan, 56.4%; standard, 46.1%; p=0.005), but not detection of sessile serrated polyps.

Nonrandomized Studies

In 2016, Albrecht assessed the sensitivity, specificity, and positive and negative predictive values of i-scan. A total of 298 images of colonic lesions were assessed by endoscopists after undergoing a dedicated training. The sensitivity was 94.2% and the specificity was 90.9%. The positive predictive value was 87.5% and the negative predictive value was 95.9%. The intraobserver agreement was 0.9301.

In 2014, a large study using modified back-to-back designs in patients undergoing screening colonoscopy was conducted by Chung in South Korea, and included 1650 adults at average risk of CRC, who were randomly divided across three groups.[53] During the colonoscopy, the endoscope was fully inserted and each of three colonic segments (ascending, transverse, descending) was inspected twice during withdrawal. Participants received first withdrawal with narrow-band imaging (NBI), virtual chromoendoscopy using FICE, or white-light colonoscopy (n=550 each group). White light was used in all groups for the second inspection. Ninety-one patients (5.5%) were excluded from analysis due to inadequate bowel preparation. For the primary outcome of adenoma detection rate, no statistically significant difference was found among the three groups. The percentage of patients with at least one adenoma was 24.5% in the NBI group, 23.6% in the FICE group, and 25.3% in the white-light group (p=0.75). Moreover, the mean number of adenomas per patient was 0.35 in the NBI group, 0.36 in the

FICE group, and 0.37 in the white-light group (p=0.59). The adenoma miss rate, defined as an adenoma identified only during the second inspection, was 22.9% in the NBI group, 26.0% in the FICE group, and 20.8% in the white-light–only group; a difference that was not statistically significant (p=0.30). The mean size of the missed adenomas was 3.6 mm, which was smaller than the mean size of adenomas found during the first withdrawal, which was 4.4 mm.

A study using a modified back-to-back colonoscopy design was published in 2012 by Kiriyama in Japan.[54] The study included 102 consecutive patients with increased risk of colon cancer who received virtual chromoendoscopy using FICE and white-light colonoscopy in random order. Patients were eligible for study inclusion if they had been referred for a colonoscopy following sigmoidoscopy or for postoperative surveillance after anterior resection. Those with known IBD, bleeding, and polyposis syndrome were excluded; the right-sided colon was examined in the remaining patients. All lesions identified on either examination were removed, and specimens were sent for evaluation. Two patients were excluded from the analysis because insertion was not possible, leaving 100 patients in the analysis. A total of 110 lesions were detected. Of these, 65 lesions were detected using FICE and 45 with white light; the difference in the number of detected lesions did not differ significantly between groups. Most of the lesions detected were neoplastic; of these, 59 (91%) were found using FICE and 38 (84%) were found with white-light colonoscopy. The miss rate was defined as the proportion of total lesions in that grouping that were detected on the second examination. The miss rate for all polyps with FICE (12/39 lesions [31%]) was significantly less than that with white light (28/61 lesions [46%]) (p=0.03). Twenty-six of 59 (44%) neoplastic lesions detected by FICE and 14 of 38 (37%) of neoplastic lesions detected by white-light colonoscopy were at least 5 mm in size. For neoplastic lesions larger than 5 mm, there was no statistically significant difference between the FICE and white-light examinations in terms of the number of lesions detected.

In 2010, Cha evaluated South Korean patients at increased risk of CRC due to a personal history of polyps or gastrointestinal symptoms.[55] A total of 135 patients underwent colonoscopy, and seven were excluded due to poor bowel preparation or diagnosis of colon cancer or intestinal disease. Thus, 128 patients were randomized to white-light colonoscopy (n=65) or virtual chromoendoscopy with FICE (n=63). The overall percentage of adenomas and the overall number of polyps did not differ significantly between groups. A total of 31 patients (49.2%) in the FICE group and 23 (35.4%) in the white-light group were found to have one or more adenomas (p=0.12). The mean number of adenomas identified per patient was also similar between groups: 1.39 in the FICE group and 1.96 in the white-light group (p=0.46). The number of adenomas less than 5 mm in size (the primary study outcome) differed significantly between groups. A total of 28 (44.4%) of patients in the FICE group and 14 (21.5%) in the white-light group (p=0.006) were found to have adenomas between 0 and 5 mm. All adenomas identified were low grade and no complications were reported in either group.

A 2010 study by Chung included 359 asymptomatic patients receiving screening colonoscopies.[56] All received back-to-back examinations with white-light colonoscopy or FICE in random order (n=181 received white light first, n=178 received FICE first). In the initial colonoscopy, a total of 60 (33.7%) of patients in the FICE group and 55 (30.4%) in the white-light group were found to have at least one adenoma; the difference between groups was not statistically significant (p=0.74). The adenoma miss rate was 6.6% in the FICE group and 8.3% in the white-light group; the difference in miss rates was not statistically significant (p=0.59). All of the missed adenomas were low grade and nonpedunculated. All but one (which was 6 mm) were 5 mm or less in size. In both Chung studies, virtual chromoendoscopy was not found to

improve the rate of adenoma detection compared with white-light endoscopy and did not identify more large adenomas.

A 2009 industry-supported multicenter RCT by Pohl in Germany compared FICE and targeted standard chromoendoscopy using indigo carmine stain.[57] The study enrolled 871 patients presenting for screening (57%) or diagnostic (43%) colonoscopy. All patients were examined using high-resolution zoom endoscopes. Patients in the group receiving standard chromoendoscopy underwent withdrawal using white-light colonoscopy. Indigo carmine was applied using a spray catheter through the working channel of the colonoscope for further assessment of any lesions that were identified. In the FICE group, withdrawal was performed using FICE at the preset for examining colorectal mucosa. Data were available for analysis on a total of 764 patients (368 in the FICE group, 396 in the standard chromoendoscopy group); 107 patients were excluded for poor bowel preparation, incomplete colonoscopy, or incomplete documentation. A total of 131 (35.6%) patients in the FICE group and 140 (35.4%) patients in the standard chromoendoscopy group had at least one adenoma; the difference between groups was not statistically significant (p=1.0). The number of small adenomas (here defined as no more than 10 mm) did not differ significantly between groups (p=0.41). The proportion of large adenomas greater than 10 mm identified in the two groups was not reported. The proportion of patients with carcinoma was small in both groups and did not differ significantly; 12 (3.3%) in the FICE group and 12 (3.0%) in the standard chromoendoscopy group (p=0.85).

PRACTICE GUIDELINE SUMMARY

NATIONAL COMPREHENSIVE CANCER NETWORK

The National Comprehensive Cancer Network (NCCN) guidelines for colorectal cancer screening (v1.2024) recommend surveillance for individuals with a personal history of ulcerative colitis or Crohn's colitis eight years after onset of symptoms using colonoscopy with high-definition white light endoscopy (HD-WLE) or chromoendoscopy with targeted biopsies.[58] Non-targeted (random) biopsies should be considered in addition to chromoendoscopy in patients with a history of dysplasia or primary sclerosing cholangitis. For people with confirmed invisible dysplasia chromoendoscopy is recommended if not already performed. For people with traversable colon stricture, the recommendation is to consider chromoendoscopy if not already performed.

U.S. MULTI-SOCIETY TASK FORCE ON COLORECTAL CANCER

The Task Force, comprised of representatives of the American College of Gastroenterology, the American Gastroenterological Association, and the American Society for Gastrointestinal Endoscopy, published recommendations for endoscopic removal of colorectal lesions in 2020.[59] The recommendations are:

Lesion assessment and description: "We suggest proficiency in the use of electronic (e.g., NBI, i-scan, Fuji Intelligent Chromoendoscopy, or blue light imaging) or dye histology (Conditional recommendation, moderate-quality evidence)."

Surveillance: To assess for local recurrence, we suggest careful examination of the post-mucosectomy scar site using enhanced imaging, such as dye-based (chromoendoscopy) or electronic-based methods, as well as obtaining targeted biopsies of the site. Post-resection scar sites that show both normal macroscopic and microscopic (biopsy) findings have the highest predictive value for long-term eradication (Conditional recommendation, moderate-

quality evidence).

This consensus-based guideline on colonoscopy surveillance after screening and polypectomy, published in 2012, stated that chromoendoscopy and narrow-band imaging may enable endoscopists to accurately determine if lesions are neoplastic, and if there is a need to remove them and send specimens to pathology. The guideline noted that, at this point, these technologies have not been studied in surveillance cohorts and therefore do not have an impact on surveillance interval.[60] The task force published evidence based recommendations for colorectal cancer screening in 2017.[61] These recommendations do not include in vivo analysis of colorectal polyps.

AMERICAN SOCIETY FOR GASTROINTESTINAL ENDOSCOPY AND AMERICAN GASTROENTEROLOGICAL ASSOCIATION

The American Gastroenterological Association (AGA) published a clinical practice update on appropriate and tailored polypectomy, based on expert review.[62] The document is focused on polyps smaller than two centimeters in size. The Best Practice Advice includes:

A structured assessment using high-definition white light and/or electronic chromoendoscopy and with photodocumentation should be conducted for all polyps found during routine colonoscopy.

In 2021, the American Gastroenterological Association (AGA) published a clinical practice update on the surveillance and management of colorectal dysplasia in patients with inflammatory bowel disease (IBD).[63] This was an expert review that underwent internal peer review by the AGA Clinical Practice Updates Committee and external peer review through standard procedures undertaken by the publishing journal (Gastroenterology).

Best Practice Statement:

- “Dye spray chromoendoscopy, performed by appropriately trained endoscopists, should be considered in all persons with colonic inflammatory bowel disease undergoing surveillance colonoscopy, particularly if a standard definition endoscope is used or if there is a history of dysplasia.”
- “Virtual chromoendoscopy is a suitable alternative to dye spray chromoendoscopy for dysplasia detection in persons with colonic inflammatory bowel disease when using high-definition endoscopy.”
- “Extensive nontargeted biopsies (roughly 4 adequately spaced biopsies every 10 cm) should be taken from flat colorectal mucosa in areas previously affected by colitis when white light endoscopy is used without dye spray chromoendoscopy or virtual chromoendoscopy. Additional biopsies should be taken from areas of prior dysplasia or poor mucosal visibility. Nontargeted biopsies are not routinely required if dye spray chromoendoscopy or virtual chromoendoscopy is performed using a high-definition endoscope, but should be considered if there is a history of dysplasia or primary sclerosing cholangitis.”
- “A finding of invisible dysplasia should prompt repeat examination by an experienced endoscopist using high-definition dye spray chromoendoscopy under optimized viewing conditions, with extensive nontargeted biopsies in the area of prior dysplasia if no lesion is seen. A finding of unresectable visible dysplasia or of invisible multifocal or high-grade dysplasia on histology should prompt colectomy. For visible lesions that can be

resected or if histologic dysplasia is not confirmed on a high-quality dye spray chromoendoscopy examination, continued endoscopic surveillance at frequent intervals is appropriate."

- "Targeted biopsies of representative or concerning pseudopolyps is appropriate during colonoscopy. Removal and sampling of all lesions is neither required nor practical. Surgery should be a last resort to manage colorectal cancer risk in the setting of severe pseudopolyposis. Dye spray chromoendoscopy should not be used to detect flat or subtle. lesions within a field of pseudopolyps."

In 2015, the American Society for Gastrointestinal Endoscopy (ASGE) and the American Gastroenterological Association (AGA) published a SCENIC consensus statement on the surveillance and management of dysplasia in patients with inflammatory bowel disease (IBD).[64] This statement, developed by an international multidisciplinary group representing a variety of stakeholders, incorporated systematic reviews of the literature. Table 1 summarizes relevant recommendations.

Table 1. Recommendations on Surveillance and Management of Dysplasia in Patients With Inflammatory Bowel Disease

Recommendation	LOA	SOR	QOE
"When performing surveillance with white-light colonoscopy, high definition is recommended rather than standard definition."	80%	Strong	Low
"When performing surveillance with standard-definition colonoscopy, chromoendoscopy is recommended rather than white-light colonoscopy."	85%	Strong	Moderate
"When performing surveillance with high-definition colonoscopy, chromoendoscopy is suggested rather than white-light colonoscopy."	84%	Conditional	Low

LOA: level of agreement; QOE: quality of evidence; SOR: strength of recommendation.

AMERICAN COLLEGE OF GASTROENTEROLOGY

In 2018, the American College of Gastroenterology (ACG) published an evidence based clinical guideline on the management of Crohn's Disease in adults.[65] The guideline makes the following statements regarding adjunct colonoscopy technologies:

- In patients at particularly high risk for colorectal neoplasia (e.g., personal history of dysplasia, primary sclerosing cholangitis), chromoendoscopy should be used during colonoscopy, as it may increase the diagnostic yield for detection of colorectal dysplasia, especially compared with standard-definition white light endoscopy (conditional recommendation, low level of evidence).
- For patients undergoing surveillance colonoscopy there is insufficient evidence to recommend universal chromoendoscopy for IBD colorectal neoplasia surveillance if the endoscopist has access to high-definition white light endoscopy (conditional recommendation, moderate level of evidence)
- Narrow-band imaging should not be used during colorectal neoplasia surveillance examinations for Crohn's disease (conditional recommendation, very low level of evidence)

In 2019, the ACG published evidence-based clinical guidelines on the management of Ulcerative Colitis in adults.[66] The guidelines make the following statements regarding adjunct

colonoscopy technologies:

- When using standard-definition colonoscopes in patients with UC undergoing surveillance, we recommend dye spray chromoendoscopy with methylene blue or indigo carmine to identify dysplasia (strong recommendation, low quality of evidence).
- When using high-definition colonoscopes in patients with UC undergoing surveillance, we suggest white-light endoscopy with narrow-band imaging or dye spray chromoendoscopy with methylene blue or indigo carmine to identify dysplasia (conditional recommendation, low quality of evidence).

SUMMARY

More research is needed to know whether in vivo assessment of colorectal lesions (including polyps) using various imaging systems as adjuncts to colonoscopy improves health outcomes. There is not enough research to show whether there would be an improvement in the selection of polyps for removal during colonoscopy. Therefore, in vivo analysis of colorectal lesions using any system is considered investigational.

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CODES

Codes	Number	Description
CPT	44799	Unlisted procedure, small intestine
	45399	Unlisted procedure, colon
	88375	Optical endomicroscopic image(s), interpretation and report, real-time or referred, each endoscopic session
HCPCS	None	

Date of Origin: *June 2002*