Confocal Laser Endomicroscopy

**Policy Number:** 2.01.87  
**Last Review:** 9/2017  
**Origination:** 3/2013  
**Next Review:** 3/2018

**Policy**
Blue Cross and Blue Shield of Kansas City (Blue KC) will not provide coverage for confocal laser endomicroscopy. This is considered investigational.

**When Policy Topic is covered**
Not Applicable

**When Policy Topic is not covered**
Use of confocal laser endomicroscopy is considered *investigational*.

**Description of Procedure or Service**

<table>
<thead>
<tr>
<th>Populations</th>
<th>Interventions</th>
<th>Comparators</th>
<th>Outcomes</th>
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</table>
| Individuals:  
* With suspected or known colorectal lesions | Interventions of interest are:  
• Confocal laser endomicroscopy as an adjunct to colonoscopy | Comparators of interest are:  
• White-light colonoscopy alone  
• Colonoscopy used with alternative adjunctive diagnostic aids | Relevant outcomes include:  
• Overall survival  
• Disease-specific survival  
• Test accuracy  
• Test validity  
• Resource utilization |
| Individuals:  
* With Barrett esophagus who are undergoing surveillance | Interventions of interest are:  
• Confocal laser endomicroscopy with targeted biopsy | Comparators of interest are:  
• Standard endoscopy with random biopsy | Relevant outcomes include:  
• Overall survival  
• Disease-specific survival  
• Test accuracy  
• Test validity  
• Resource utilization |
| Individuals:  
* With gastrointestinal lesions and have had endoscopic treatment | Interventions of interest are:  
• Confocal laser endomicroscopy to assess adequacy of endoscopic treatment | Comparators of interest are:  
• Standard endoscopy (ie, white-light endoscopy) | Relevant outcomes include:  
• Overall survival  
• Disease-specific survival  
• Test accuracy  
• Test validity  
• Resource utilization |
| Individuals:  
* With suspicion of a condition diagnosed by identification and biopsy of lesions (eg, lung, bladder, or gastric cancer) | Interventions of interest are:  
• Confocal laser endomicroscopy | Comparators of interest are:  
• Standard diagnostic procedures | Relevant outcomes include:  
• Overall survival  
• Disease-specific survival  
• Test accuracy  
• Test validity  
• Resource utilization |

Confocal laser endomicroscopy (CLE), also known as confocal fluorescent endomicroscopy and optical endomicroscopy, allows *in vivo* microscopic imaging of cells during endoscopy. CLE is proposed for a variety of purposes, especially as a
real-time alternative to histology during colonoscopy and for targeting areas to undergo biopsy in patients with inflammatory bowel disease and Barrett’s esophagus.

For individuals who have suspected or known colorectal lesions who receive CLE as an adjunct to colonoscopy, the evidence includes multiple diagnostic accuracy studies. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. While the reported sensitivity and specificity in these studies are high, it is uncertain whether the accuracy is sufficiently high to replace biopsy/polypectomy and histopathologic analysis. Moreover, issues remain about the use of this technology in practice (eg, the learning curve, interpretation of lesions). The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have Barrett esophagus who are undergoing surveillance who receive CLE with targeted biopsy, the evidence includes several randomized controlled trials (RCTs) and a meta-analysis. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. Evidence from RCTs has suggested CLE is more sensitive than standard endoscopy for identifying areas of dysplasia. However, a 2014 meta-analysis found that the pooled sensitivity, specificity, and negative predictive value of available studies were not sufficiently high to replace the standard surveillance protocol. National guidelines continue to recommend 4-quadrant random biopsies for patients with Barrett esophagus undergoing surveillance. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have gastrointestinal lesions and have had endoscopic treatment who receive CLE, the evidence includes 1 RCT and a systematic review. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. The single RCT, which compared high definition (HD) white-light endoscopy with HD white-light endoscopy plus CLE, was stopped early because an interim analysis did not find a between-group difference in outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have a suspicion of a condition diagnosed by identification and biopsy of lesions (eg, lung, bladder, or gastric cancer) who receive CLE, the evidence includes a small number of diagnostic accuracy studies. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. There is limited evidence on the diagnostic accuracy of these other indications. The evidence is insufficient to determine the effects of the technology on health outcomes.

**Background**

CLE, also known as confocal fluorescent endomicroscopy and optical endomicroscopy, allows in vivo microscopic imaging of the mucosal epithelium during endoscopy. The process involves using light from a low-power laser to illuminate tissue and, subsequently, the same lens detects light reflected from the
tissue through a pinhole. The term confocal refers to having both illumination and collection systems in the same focal plane. Light reflected and scattered at other geometric angles that is not reflected through the pinhole is excluded from detection, which dramatically increases the special resolution of CLE images.

To date, 2 types of CLE systems have been cleared by the U.S. Food and Drug Administration (FDA). One is an endoscope-based system in which a confocal probe is incorporated onto the tip of a conventional endoscope. The other is a probe-based system; the probe is placed through the biopsy channel of a conventional endoscope. The depth of view is up to 250 um with the endoscopic system and about 120 um with the probe-based system. A limited area can be examined; no more than 700 um in the endoscopic-based system and less with the probe-based system. As pointed out in review articles, the limited viewing area emphasizes the need for careful conventional endoscopy to target the areas for evaluation. Both CLE systems are optimized using a contrast agent. The most widely used agent is intravenous fluorescein, which is FDA-approved for ophthalmologic imaging of blood vessels when used with a laser scanning ophthalmoscope.

Unlike techniques such as chromoendoscopy, which are primarily intended to improve the sensitivity of colonoscopy, CLE is unique in that it is designed to immediately characterize the cellular structure of lesions. CLE can thus potentially be used to make a diagnosis of polyp histology, particularly in association with screening or surveillance colonoscopy, which could allow for small hyperplastic lesions to be left in place rather than removed and sent for histological evaluation. This would reduce risks associated with biopsy and reduce the number of biopsies and histological evaluations.

Another key potential application of CLE technology is targeting areas for biopsy in patients with BE undergoing surveillance endoscopy. This is an alternative to the current standard approach recommended by the American Gastroenterological Association (AGA) which is that patients with BE who do not have dysplasia undergo endoscopic surveillance every 3 to 5 years.1 AGA further recommends that random 4-quadrant biopsies every 2 cm be taken with white-light endoscopy in patients without known dysplasia.

Other potential uses of CLE under investigation include better diagnosis and differentiation of conditions such as gastric metaplasia, lung cancer, and bladder cancer.

As noted previously, limitations of CLE systems include a limited viewing area and depth of view. Another issue is standardization of systems for classifying lesions viewed with CLE devices. Although there is not currently an internationally accepted classification system for colorectal lesions, 2 systems have been developed that have been used in a number of studies conducted in different countries. These are the Mainz criteria for endoscopy-based CLE devices and the Miami classification system for probe-based CLE devices. (2) Lesion classification systems are less developed for non-gastrointestinal lesions viewed by CLE devices.
e.g., those in the lung or bladder. Another potential issue is the learning curve for obtaining high-quality images and classifying lesions. Several recent studies, however, have found that the ability to acquire high-quality images and interpret them accurately can be learned relatively quickly; these studies were limited to colorectal applications of CLE. (3, 4)

**Regulatory Status**

Two confocal laser endomicroscopy devices have been cleared for marketing by the FDA. These include:

**Cellvizio® (Mauna Kea Technologies; Paris, France):** This is a confocal microscopy with a fiber optic probe (i.e., a probe-based CLE system). The device consists of a laser scanning unit, proprietary software, a flat-panel display and miniaturized fiber optic probes. The F-600 system, cleared by the FDA in 2006, can be used with any standard endoscope with a working channel of at least 2.8 mm. According to FDA documents, the device is intended for confocal laser imaging of the internal microstructure of tissues in the anatomical tract (gastrointestinal or respiratory) that are accessed by an endoscope.

**Confocal Video Colonoscope (Pentax Medical Company: Montvale, NJ):** This is an endoscopy-based CLE system. The EC-3S7OCILK system, cleared by the FDA in 2004, is used with a Pentax Video Processor and with a Pentax Confocal Laser System. According to FDA materials, the intended use of the device is to provide optical and microscopic visualization of and therapeutic access to the lower gastrointestinal tract.

**Rationale**

This evidence review was originally created in January 2013 with a search of the MEDLINE database. The review has been updated regularly; most recently the literature was reviewed through September 26, 2016. Following is a summary of the key literature.

**Colorectal Lesions**

**Diagnostic Accuracy**

**Systematic Reviews**

Several systematic reviews of studies have compared the diagnostic accuracy of confocal laser endomicroscopy (CLE) with a reference standard. In 2013, Su et al reviewed studies on the efficacy of CLE for discriminating colorectal neoplasms from non-neoplasms. To be included in the review, studies had to use histologic biopsy as the reference standard and the pathologist and endoscopist had to be blinded to each other's findings. Selected studies also used a standardized CLE classification system. Patients had to be at increased risk of colorectal cancer (CRC) due to personal or family history, have previously identified polyps, and/or have inflammatory bowel disease (IBD). Two reviewers independently assessed the quality of individual studies using the modified Quality Assessment of
Diagnostic Accuracy Studies (QUADAS) tool, and studies considered at high risk of bias were excluded from further consideration.

Fifteen studies (total N=719 adults) were eligible for the systematic review. All were single-center trials and 2 were available only as abstracts. In all studies, suspicious lesions were first identified by conventional white-light endoscopy with or without chromoendoscopy and then further examined by CLE. Meta-analysis of the 15 studies found an overall sensitivity for CLE of 94% (95% confidence interval [CI], 88% to 97%) and a specificity of 95% (95% CI, 89% to 97%) compared with histology. Six studies included patients at increased risk of CRC who were undergoing surveillance endoscopy; 5 studies included patients with colorectal polyps and 4 studies included patients with IBD. In a predefined subgroup analysis by indication for screening, the pooled sensitivity and specificity for surveillance studies were 94% (95% CI, 90% to 97%) and 98% (95% CI, 97% to 99%), respectively. For patients presenting with colorectal polyps, the pooled sensitivity of CLE was 91% (95% CI, 87% to 94%) and the specificity was 85% (95% CI, 78% to 90%). For patients with IBD, the pooled sensitivity was 83% (95% CI, 70% to 92%) and the specificity was 90% (95% CI, 87% to 93%). In other predefined subgroup analyses, the summary sensitivity and specificity were significantly higher (p<0.001) in studies of endoscopy-based CLE (97% and 99%, respectively) than in studies of probe-based CLE (87% and 82%, respectively). In addition, the summary sensitivity and specificity were significantly higher (p<0.01) with real-time CLE in which the macroscopic endoscopy findings were known (96% and 97%, respectively) than in blinded CLE in which recorded confocal images were subsequently analyzed without knowledge of macroscopic endoscopy findings (85% and 82%, respectively).

Another 2013 systematic review by Dong et al included studies that compared the diagnostic accuracy of CLE with conventional endoscopy. Reviewers did not explicitly state that the reference standard was histologic biopsy, but this was the implied reference standard. Six studies were included in a meta-analysis. All were prospective, and at least 5 included blinded interpretation of CLE findings (in 1 study, it was unclear whether interpretation was blinded). In a pooled analysis of data from all 6 studies, the sensitivity was 81% (95% CI, 77% to 85%) and the specificity was 88% (95% CI, 85% to 90%). Reviewers also conducted a subgroup analysis by type of CLE used. When findings from the 2 studies on endoscopy-based CLE were pooled, the sensitivity was 82% (95% CI, 69% to 91%) and the specificity was 94% (95% CI, 91% to 96%). Two studies may not have been sufficient to obtain a reliable estimate of diagnostic accuracy. When findings from the 4 studies on probe-based endoscopy were pooled, the sensitivity was 81% (95% CI, 76% to 85%) and the specificity was 75% (95% CI, 69% to 81%).

A 2013 meta-analysis by Wanders et al searched for studies that reported the diagnostic accuracy of several new technologies used to differentiate between colorectal neoplasms and non-neoplasms. To be selected, studies had to use the technology to differentiate between non-neoplastic and neoplastic lesions and to use histopathology as the reference standard. Blinding was not an inclusion criterion. Eleven eligible studies identified included an analysis of CLE. Meta-
analysis yielded an estimated sensitivity of 93.3% (95% CI, 88.4% to 96.2%) and a specificity of 89.9% (95% CI, 81.8% to 94.6%). Meta-analysis limited to the 5 studies that used endoscopy-based CLE found a sensitivity of 94.8% (95% CI, 90.6% to 98.92%) and a specificity of 94.4% (95% CI, 90.7% to 99.2%). When findings of the 6 probe-based CLE studies were pooled, sensitivity was 91.5% (95% CI, 86.0% to 97.0%) and specificity was 80.9 (95% CI, 69.4% to 92.4%).

**Cohort Studies**

A 2011 study by Xie et al in China included 116 consecutive patients who had polyps found during CLE (1 patient was excluded from the analysis). All patients had an indication for colonoscopy (19 were undergoing surveillance after polypectomy, 2 had a family history of CRC, 3 had IBD, 91 were seeking a diagnosis). All patients first underwent white-light colonoscopy. Endoscopy-based CLE was used on the first polyp identified during withdrawal of the endoscope (ie, 1 polyp per patient was analyzed). Intravenous fluorescein sodium was used. Real-time diagnosis of the polyp was performed based on criteria used at the study center (adapted from the Mainz classification system). The polyps were biopsied or removed, and histopathologic diagnosis was determined. Real-time CLE diagnosis correctly identified 109 (95%) of 115 adenomas or hyperplastic polyps. Four adenomas were misdiagnosed by CLE as hyperplastic polyps (2 were tubulous adenomas, 2 were tubulovillous adenomas) and 2 hyperplastic polyps were misdiagnosed as adenomas. The overall sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CLE diagnosis were 93.9% (95% CI, 85.4% to 97.6%), 95.9% (95% CI, 86.2% to 98.9%), 96.9% (95% CI, 89% to 99%), and 94.8% (95% CI, 89.1% to 97.6%), respectively. For polyps less than 10 mm, CLE diagnosis had a sensitivity of 90.3% and a specificity of 95.7%; for polyps 10 mm and larger, sensitivity was 97.1% and specificity was 100%.

In 2010, Buchner et al published findings on 75 patients who had a total of 119 polyps. Patients were eligible for participation if they were undergoing surveillance or screening colonoscopy or undergoing evaluation of known or suspected polyps identified by other imaging modalities or endoscopic resection of larger flat colorectal neoplasia. White-light colonoscopy was used as the primary screening method. When a suspicious lesion was identified, it was evaluated by virtual chromoendoscopy and a probe-based CLE system. Intravenous fluorescein sodium was administered after the first polyp was identified. After the imaging techniques, the appropriate intervention (ie, polypectomy, biopsy, endoscopic mucosal resection [EMR]) was performed and all resected specimens underwent histopathologic analysis by a pathologist blinded to CLE information. Confocal images of the 199 polyps were evaluated after all procedures were completed; the evaluator was blinded to histology diagnosis and endoscopic appearance of the lesion. Diagnosis of confocal images used modified Mainz criteria; polyps were classified as benign or neoplastic. According to histopathologic analysis, there were 38 hyperplastic polyps and 81 neoplastic lesions. CLE correctly identified 74 of 81 neoplastic polyps (sensitivity, 91%; 95% CI, 83% to 96%). In addition, CLE correctly identified 29 of 38 hyperplastic polyps (specificity, 76%; 95% CI, 60% to 89%). In contrast, virtual chromoendoscopy correctly identified 62 neoplastic
polyps (sensitivity, 77%; 95% CI, 66% to 85%) and 27 hyperplastic polyps (specificity, 71%; 95% CI, 54% to 85%).

Another study from the same academic medical center as Buchner was published in 2012 by Shadid et al. It compared 2 methods of analyzing CLE images: real-time diagnosis and blinded review of video images after endoscopy (known as “offline” diagnosis). The study included 74 patients with a total of 154 colorectal lesions. Eligibility criteria were similar to the Buchner study (previously discussed)—selected patients were undergoing surveillance or screening colonoscopy. Patients had white-light colonoscopy and identified polyps were also evaluated with virtual chromoendoscopy and probe-based CLE. Intravenous fluorescein sodium was administered after the first polyp was identified. At examination, an endoscopist made a real-time diagnosis based on CLE images. Based on that diagnosis, the patient underwent polypectomy, biopsy, or endoscopic mucosal resection, and histopathologic analysis was done on the specimens. CLE images were deidentified and reviewed offline by the same endoscopist at least 1 month later. At the second review, the endoscopist was blinded to the endoscopic and histopathologic diagnosis. Of the 154 polyps, 74 were found by histopathologic analysis to be non-neoplastic and 80 were neoplastic (63 tubular adenomas, 12 tubulovillous adenomas, 3 mixed hyperplastic-adenoma polyps, 2 adenocarcinomas). Overall, there was no statistically significant difference in the diagnostic accuracy between real-time CLE diagnosis and blinded offline CLE diagnosis (ie, confidence intervals overlapped). The sensitivity, specificity, PPV, and NPV for real-time CLE diagnosis were 81%, 76%, 87%, and 79%, respectively. For offline diagnosis, these values were 88%, 77%, 81%, and 85%, respectively. For larger polyps, there was a nonsignificant trend in favor of better diagnostic accuracy with real-time compared with offline CLE. However, in the subgroup of 107 smaller polyps (<10 mm in size), the accuracy of real-time CLE was significantly less than offline CLE. For smaller polyps, sensitivity, specificity, PPV and NPV of real-time CLE were 71%, 83%, 78%, and 78%, respectively; for offline CLE, they were 86%, 78%, 76%, and 87%, respectively.

A 2011 study by Hlavaty et al in Slovakia included patients with ulcerative colitis or Crohn disease. Thirty patients were examined with standard white-light colonoscopy, chromoendoscopy, and an endoscopy-based CLE system. Another 15 patients were examined only with standard colonoscopy. All lesions identified by white-light colonoscopy or chromoendoscopy were examined using CLE to identify neoplasia using the Mainz classification system. Suspicious lesions were biopsied and random biopsies were taken from 4 quadrants every 10 cm per the standard surveillance colonoscopy protocol. All specimens underwent histologic analysis by a gastrointestinal pathologist blinded to CLE diagnosis. Diagnostic accuracy of CLE was calculated for examinable lesions only. Compared with histologic diagnosis, the sensitivity of CLE for diagnosing low-grade and high-grade intraepithelial neoplasia was 100%, specificity was 98.4%, PPV was 66.7%, and NPV was 100%. However, whereas CLE was able to examine 28 (93%) of 30 flat lesions, it could examine only 40 (57%) of 70 protruding polyps. Moreover, 6 (60%) of 10 dysplastic lesions, including 3 of 5 low-grade and high-grade intraepithelial
neoplasms were not evaluable by CLE. It is also worth noting that the diagnostic accuracy of chromoendoscopy (see evidence review 2.01.84) was similar to that of CLE. The sensitivity, specificity, PPV, and NPV of chromoendoscopy were 100%, 97.9%, 75%, and 100%, respectively.

**Clinical Utility**
In patients at average risk of CRC, no randomized controlled trials (RCTs) or nonrandomized comparative studies were identified that have evaluated the impact of CLE on subsequent development of CRC or on CRC mortality. In addition, it is not clear that the diagnostic performance of this technology is sufficient to obviate the need for biopsy of identified polyp lesions. Thus there is insufficient evidence to support a chain of indirect evidence to demonstrate an improvement in net health outcome.

**Section Summary: Colorectal Lesions**
Multiple studies have compared the accuracy of CLE with the histopathology for diagnosing colorectal lesions. In 3 published systematic reviews, pooled estimates of overall sensitivity of CLE ranged from 81% to 94%, and pooled estimates of the specificity ranged from 88% to 95%. Although the reported diagnostic accuracy tended to be relatively high, it is unclear whether the accuracy is high enough to replace biopsy/polypectomy and histologic analysis. Moreover, there are no controlled studies on the impact of using CLE on CRC incidence or mortality, and the available evidence is insufficient to support a chain of indirect evidence.

**Barrett Esophagus**
This section addresses whether CLE can distinguish Barrett esophagus (BE) without dysplasia from BE with low- (LGD) and high-grade dysplasia (HGD) and/or lead to fewer biopsies of benign tissue compared with surveillance with random biopsies. The ideal study to answer this question would include an unselected clinical population of patients with BE presenting for surveillance and would randomly assign patients to CLE with targeted biopsy or a standard biopsy protocol without CLE. Relevant outcomes include diagnostic accuracy for detecting dysplasia, the detection rate for dysplasia, and the number of biopsies.

**Systematic Reviews**
In 2014, Gupta et al published a systematic review and meta-analysis of prospective studies comparing the accuracy of CLE with targeted biopsy to standard 4-quadrant biopsy in patients with BE. Reviewers noted that, according to the Preservation and Incorporation of Valuable Endoscopic Innovation (PIVI) Initiative of the American Society of Gastrointestinal Endoscopy (ASGE), in order to replace the standard Seattle protocol, an alternative approach would need to have a per-patient sensitivity of at least 90%, specificity of at least 80%, and NPV of at least 98% for detecting HGD or esophageal adenocarcinoma (HGD/EAC) compared with the current protocol.

Eight studies published through May 2014 met inclusion criteria; 1 was a parallel-group RCT, and 1 was a randomized crossover study. The other 6 were single- or double-blind nonrandomized comparative studies. Seven studies had data suitable
for pooling on a per-lesion basis; together they included 345 patients and 3080 lesions. In a meta-analysis of the diagnosis of HGD/EAC, pooled sensitivity was 68% (95% CI, 64% to 73%) and pooled specificity was 88% (95% CI, 87% to 89%). Four studies were included in the per-patient meta-analysis. The pooled sensitivity and specificity were 86% (95% CI, 74% to 96%) and 83% (95% CI, 77% to 88%), respectively. NPV (calculated using the sensitivity, specificity, and overall prevalence) was 96%. Thus, according to the criteria in the PIVI Initiative, the diagnostic accuracy of CLE in the studies published to date is not sufficiently high for this technique to replace HGD/EAC were much higher in the studies included in the meta-analysis than is generally seen in clinical practice and therefore diagnostic accuracy results should be interpreted cautiously.

In 2016, Xiong et al published a meta-analysis of prospective studies evaluating the diagnostic accuracy of CLE in patients with BE, using histopathologic analysis as the criterion standard. Studies were not required to compare CLE to standard 4-quadrant biopsy. Fourteen studies were included. In a pooled analysis 7 studies (n=473 patients) reporting a per-patient analysis, the sensitivity of CLE for detecting neoplasia was 89% (95% CI, 82% to 94%) and the specificity was 83% (95% CI, 78% to 86%). The pooled positive and negative likelihood ratios were 6.53 (95% CI, 3.12 to 13.4) and 0.17 (95% CI, 0.11 to 0.29, respectively). Reviewers did not report PPV or NPV. Moreover, they provided estimates of pretest probability to aid in the interpretation of the likelihood ratios (ie, to evaluate a person’s risk level before and after getting the test). Sensitivity and specificity were similar to those calculated in the 2014 systematic review by Gupta et al.

**Randomized Controlled Trials**

In 2011, Sharma et al published an international, multicenter RCT that included 122 consecutive patients presenting for surveillance of BE or endoscopic treatment of HGD or early carcinoma. Patients were randomized to both standard white-light endoscopy and narrow-band imaging. Following these 2 examinations, done in a blinded fashion, location of lesions was unblinded and, subsequently, all patients underwent probe-based CLE. All examinations involved presumptive diagnosis of suspicious lesions. Also, in both groups, after all evaluations were performed, all suspicious lesions were biopsied, as well as random locations (4 quadrants every 2 cm). Histopathologic analysis was the reference standard. Twenty-one patients were excluded from the analysis. Of the remaining 101 patients, 66 (65%) were found on histopathologic analysis to have no dysplasia, 4 (4%) had LGD, 6 (6%) had HGD, and 25 (25%) had early carcinoma. Sensitivity of CLE plus white-light endoscopy for detecting HGD or early carcinoma was 68.3% (95% CI, 60.0% to 76.7%), which was significantly higher than white-light endoscopy alone (34.2%; 95% CI, 25.7% to 42.7%; p=0.002). However, specificity of CLE plus white-light endoscopy was significantly lower (87.8%; 95% CI, 85.5% to 90.1%) than white-light endoscopy alone (92.7%; 95% CI, 90.8% to 94.6%; p<0.001). For white-light endoscopy alone, PPV was 42.7% (95% CI, 32.8% to 52.6%), and NPV was 89.8% (95% CI, 87.7% to 92.0%). For white-light endoscopy with probe-based CLE, PPV was 47.1% (95% CI, 39.7% to 54.5%), and NPV was 94.6% (95% CI, 92.9% to 96.2%). White-light endoscopy alone missed 79 (66%) of 120 areas with HGD or early carcinoma, and white-light
endoscopy plus CLE missed 38 (32%) areas. On a per-patient basis, 31 patients were diagnosed with HGD or early carcinoma. White-light endoscopy alone failed to identify 4 of these patients (sensitivity, 87%), whereas white-light endoscopy plus CLE failed to identify 2 patients (sensitivity, 93.5%).

A single-center crossover RCT was published in 2009 by Dunbar et al. \(^{15}\) Forty-six patients with BE were enrolled, and 39 (95%) completed the study protocol. Of these, 23 were undergoing BE surveillance and 16 had BE with suspected neoplasia. All patients received endoscopy-based CLE and standard endoscopy, in random order. One endoscopist performed all CLE procedures and another endoscopist performed all standard endoscopy procedures; endoscopists were blinded to the finding of the other procedure. During the standard endoscopy procedure, biopsies were taken of any discrete lesions followed by 4-quadrant random biopsy (every 1 cm for suspected neoplasia and every 2 cm for BE surveillance). During the CLE procedure, only lesions suspicious of neoplasia were biopsied. Endoscopists interpreted CLE images using the Confocal Barrett’s Classification system, developed in a previous research study. Histopathologic analysis was the reference standard. Among the 16 study completers with suspected high-risk dysplasia, there were significantly fewer biopsies per patient with CLE (mean, 9.8 biopsies per patient) than with standard endoscopy (mean, 23.9 biopsies per patient; \(p=0.002\)). Although there were fewer biopsies, the mean number of biopsy specimens showing HGD or cancer was similar in the 2 groups (3.1 during CLE vs 3.7 during standard endoscopy). The diagnostic yield for neoplasia was 33.7% with CLE and 17.2% with standard endoscopy. None of the 23 patients undergoing BE for surveillance had HGD or cancer. The mean number of mucosal specimens obtained for patients in this group was 12.6 with white-light endoscopy and 1.7 with CLE (\(p<0.001\)).

Another RCT was published in 2014 by Canto et al. \(^{16}\) This single-blind, multicenter trial was conducted at academic centers with experienced endoscopists. It included consecutive patients undergoing endoscopy for routine BE surveillance or for suspected or known neoplasia. Patients were randomized to high-definition (HD) white-light endoscopy with random biopsy (\(n=98\)) or white-light endoscopy with endoscopy-based CLE and targeted biopsy (\(n=94\)). In the white-light endoscopy-only group, 4-quadrant random biopsies were taken every 1 to 2 cm over the entire length of the BE for patients undergoing surveillance and every 1 cm for patients with suspected neoplasia. In the CLE group, biopsy specimens were obtained only when there was CLE evidence of neoplasia. Final pathologic diagnosis was the reference standard. A per-patient analysis of diagnostic accuracy for diagnosing BE-related neoplasia found a sensitivity of 40% with white-light endoscopy only and 95% with white-light endoscopy plus CLE. Specificity was 98% with white-light endoscopy only and 92% with white-light endoscopy plus CLE. When the analysis was done on a per-biopsy specimen basis, when CLE was added, sensitivity was substantially higher and specificity was slightly lower. The median number of biopsies per patient was significantly higher in the white-light endoscopy group (\(n=4\)) compared with the CLE group (\(n=2; p<0.001\)).
The investigators analyzed the number of cases in which CLE resulted in a different diagnosis. Thirty-two (34%) of 94 patients in the white-light plus CLE group had a correct change in dysplasia grade after CLE compared with initial endoscopic findings. Six (19%) of the 32 patients had lesions, and the remaining 26 did not. In 21 of the 26 patients without lesions, CLE changed the plan from biopsy to no biopsy. The remaining 62 (65%) of 94 patients in the white-light endoscopy plus CLE group had concordant diagnoses with both techniques. Because the trial was conducted at academic centers and used endoscopy-based CLE, findings may not be generalizable to other clinical settings or to probe-based CLE.

**Section Summary: Barrett Esophagus**

Several RCTs and nonrandomized comparative studies evaluating CLE for detecting dysplasia and neoplasia in patients with BE have been published. A 2014 meta-analysis found that the pooled sensitivity, specificity, and NPV in available studies were not sufficiently high to replace the standard Seattle protocol, according to criteria adopted by the ASGE. There are limited data comparing standard protocols using random biopsies to protocols using CLE and targeted biopsies; therefore, data are inconclusive on the potential for CLE to reduce the number of biopsies in patients with BE undergoing surveillance without compromising diagnostic accuracy. Moreover, studies do not appear to have used a consistent approach to classifying lesions as dysplastic using CLE.

**Adequacy of Endoscopic Treatment of Gastrointestinal Lesions**

This section addresses whether use of CLE improves the determination of residual disease compared with conventional techniques (ie, white-light endoscopy). In 2015, Ypsilantis et al published a systematic review that included retrospective and prospective studies reporting the diagnostic accuracy of CLE for the detection of residual disease after EMR of gastrointestinal lesions. After examining full-text articles, 3 studies (1 RCT, 2 prospective, nonrandomized comparative studies) met the eligibility criteria. Studies included patients with BE, gastric neoplasia, and colorectal neoplasia. There was significant heterogeneity among studies. In a per-lesion meta-analysis, pooled sensitivity of CLE for detecting neoplasia was 91% (95% CI, 83% to 96%) and pooled specificity was 69% (95% CI, 61% to 76%). Based on the small number of studies and heterogeneity among studies, reviewers concluded that the evidence on the usefulness of CLE in assessing the adequacy of EMR is weak.

The single RCT in the Ypsilantis review was published in 2012 by Wallace et al. This multicenter trial included patients with BE who were undergoing ablation. After an initial attempt at ablation, patients were randomized to follow-up with HD white-light endoscopy or HD white-light endoscopy plus CLE. The primary outcome was the proportion of optimally treated patients, defined as those with no evidence of disease at follow-up, and those with residual disease who were identified and treated. Trial enrollment was halted after an interim analysis showed no difference between groups. Among the 119 patients enrolled at the interim analysis, 15 (26%) of 57 in the HD white-light endoscopy group and 17 (27%) of 62 in the HD
white-light endoscopy plus CLE group were optimally treated; the difference was not statistically significant. Moreover, other outcomes were similar in the 2 groups.

**Section Summary: Adequacy of Endoscopic Treatment of Gastrointestinal Lesions**

There is insufficient evidence that CLE improves on standard practice for assessing the adequacy of endoscopic treatment of gastrointestinal lesions. The single RCT on this topic was stopped early because an interim analysis found that CLE did not improve on HD white-light endoscopy.

**Other Potential Applications of CLE**

Studies have evaluated CLE for diagnosing a variety of conditions, including lung cancer,\(^{19-21}\) bladder cancer,\(^{22,23}\) head and neck cancer,\(^{24,25}\) esophageal cancer,\(^{26,27}\) atrophic gastritis,\(^{28}\) gastric cancer,\(^{29,30}\) pancreatic cysts,\(^{31,32}\) breast surgery,\(^{33}\) and biliary strictures.\(^{34}\) These studies are insufficient to determine the accuracy of CLE and its potential role in clinical care for patients with these conditions.

**Summary of Evidence**

For individuals who have suspected or known colorectal lesions who receive confocal laser endomicroscopy (CLE) as an adjunct to colonoscopy, the evidence includes multiple diagnostic accuracy studies. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. While the reported sensitivity and specificity in these studies are high, it is uncertain whether the accuracy is sufficiently high to replace biopsy/polypectomy and histopathologic analysis. Moreover, issues remain about the use of this technology in practice (eg, the learning curve, interpretation of lesions). The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have Barrett esophagus who are undergoing surveillance who receive CLE with targeted biopsy, the evidence includes several randomized controlled trials (RCTs) and a meta-analysis. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. Evidence from RCTs has suggested CLE is more sensitive than standard endoscopy for identifying areas of dysplasia. However, a 2014 meta-analysis found that the pooled sensitivity, specificity, and negative predictive value of available studies were not sufficiently high to replace the standard surveillance protocol. National guidelines continue to recommend 4-quadrant random biopsies for patients with Barrett esophagus undergoing surveillance. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have gastrointestinal lesions and have had endoscopic treatment who receive CLE, the evidence includes 1 RCT and a systematic review. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. The single RCT, which compared high definition (HD) white-light endoscopy with HD white-light endoscopy plus CLE, was stopped early because an interim analysis did not find a between-group difference in
outcomes. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have a suspicion of a condition diagnosed by identification and biopsy of lesions (eg, lung, bladder, or gastric cancer) who receive CLE, the evidence includes a small number of diagnostic accuracy studies. Relevant outcomes are overall survival, disease-specific survival, test accuracy and validity, and resource utilization. There is limited evidence on the diagnostic accuracy of these other indications. The evidence is insufficient to determine the effects of the technology on health outcomes.

Supplemental Information

Practice Guidelines and Position Statements

American Society for Gastrointestinal Endoscopy

In 2006 (reaffirmed in 2011), the American Society for Gastrointestinal Endoscopy (ASGE) published guidelines on the role of endoscopy in the surveillance of premalignant conditions of the upper gastrointestinal (GI) tract. The guidelines included the following statements on surveillance of patients with Barrett esophagus (BE):

2. “The cost effectiveness of surveillance in patients without dysplasia is controversial. Surveillance endoscopy is appropriate for patients fit to undergo therapy, should endoscopic/histologic findings dictate. For patients with established Barrett’s esophagus of any length and with no dysplasia, after 2 consecutive examinations within 1 year, an acceptable interval for additional surveillance is every 3 years.”

3. “Patients with high-grade dysplasia are at significant risk for prevalent or incident cancer. Patients who are surgical candidates may elect to have definitive therapy. Patients who elect surveillance endoscopy should undergo follow-up every 3 months for at least 1 year, with multiple large capacity biopsy specimens obtained at 1 cm intervals. After 1 year of no cancer detection, the interval of surveillance may be lengthened if there are no dysplastic changes on 2 subsequent endoscopies performed at 3-month intervals. High-grade dysplasia should be confirmed by an expert GI pathologist.”

4. “Surveillance in patients with low-grade dysplasia is recommended. The significance of low-grade dysplasia as a risk factor for cancer remains poorly defined; therefore, the optimal interval and biopsy protocol has not been established. A follow-up EGD [screening esophagogastroduodenoscopy] (i.e., at 6 months) should be performed with concentrated biopsies in the area of dysplasia. If low-grade dysplasia is confirmed, then one possible management scheme would be surveillance at 12 months and yearly thereafter as long as dysplasia persists.”

ASGE published a technology status evaluation report on confocal laser endomicroscopy (CLE) in 2014. It concluded that CLE is an emerging technology
with the potential to improve patient care. However, before it can be widely accepted, further studies are needed in the following areas:

1. “[T]he applicability and practicality of CLE, especially in community settings [because the research has been done] primarily in academic centers.”
2. The “learning curve of CLE image interpretation ... and additional time needed to perform the procedure....”
3. The clinical efficacy of the technology ... compared to other available advanced imaging technologies....”
4. Improvements in CLE imaging and image interpretation....”

**American Gastroenterological Association**

In 2011, the American Gastroenterological Association published a position statement on the management of BE. The statement included the following recommendations on endoscopic surveillance of BE:

“The guideline developers suggest that endoscopic surveillance be performed in patients with Barrett’s esophagus (weak recommendation, moderate-quality evidence).

The guideline developers suggest the following surveillance intervals (weak recommendation, low-quality evidence):

- No dysplasia: 3-5 years
- Low-grade dysplasia: 6-12 months
- High-grade dysplasia in the absence of eradication therapy: 3 months”

“For patients with Barrett’s esophagus who are undergoing surveillance, the guideline developers recommend:

- Endoscopic evaluation be performed using white light endoscopy (strong recommendation, moderate-quality evidence).
- 4-quadrant biopsy specimens be taken every 2 cm (strong recommendation, moderate-quality evidence).
- Specific biopsy specimens of any mucosal irregularities be submitted separately to the pathologist (strong recommendation, moderate-quality evidence).
- 4-quadrant biopsy specimens be obtained every 1 cm in patients with known or suspected dysplasia (strong recommendation, moderate-quality evidence).

The guideline developers suggest against requiring chromoendoscopy or advanced imaging techniques for the routine surveillance of patients with Barrett’s esophagus at this time (weak recommendation, low-quality evidence).”

**U.S. Preventive Services Task Force Recommendations**

The U.S. Preventive Services Task Force recommendations on colorectal cancer screening do not mention CLE.
Medicare National Coverage
There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

Ongoing and Unpublished Clinical Trials
Some currently unpublished trials that might influence this review are listed in Table 1.

Table 1. Summary of Key Trials

<table>
<thead>
<tr>
<th>NCT No.</th>
<th>Trial Name</th>
<th>Planned Enrollment</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCT02515721</td>
<td>PCLE for the Diagnosis of Gastric Intestinal Metaplasia, Intraepithelial Neoplasia, and Carcinoma</td>
<td>242</td>
<td>Aug 2015 (ongoing)</td>
</tr>
<tr>
<td>NCT02552004</td>
<td>Assessment of Intraoperative Probe-based Confocal Laser Endomicroscopy in Digestive and Endocrine Surgery: a Pilot Study (Pilot pCLE)</td>
<td>30</td>
<td>Oct 2016 (ongoing)</td>
</tr>
<tr>
<td>NCT02930616</td>
<td>A Comparison of pCLE Based Targeted Biopsy and WLE Based Standard Biopsy in Staging the Operative Link on Gastric Intestinal Metaplasia (OLGIM): A Randomized Cross-over Study</td>
<td>40</td>
<td>Jun 2017</td>
</tr>
<tr>
<td>NCT02799420</td>
<td>Role of Probe-based Confocal Laser Endomicroscopy Targeted Biopsy in the Molecular Study of Undifferentiated Gastric Cancer</td>
<td>64</td>
<td>May 2017</td>
</tr>
</tbody>
</table>

NCT: national clinical trial.

References


**Billing Coding/Physician Documentation Information**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0397T</td>
<td>Endoscopic retrograde cholangiopancreatography (ERCP), with optical endomicroscopy (List separately in addition to code for primary procedure) (new code 1/1/2016)</td>
</tr>
<tr>
<td>43206</td>
<td>Esophagoscopy, flexible, transoral; with optical endomicroscopy</td>
</tr>
<tr>
<td>43252</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with optical endomicroscopy</td>
</tr>
<tr>
<td>88375</td>
<td>Optical endomicroscopic image(s), interpretation and report, real-time or referred, each endoscopic session</td>
</tr>
</tbody>
</table>

**ICD10 Codes**

- K22.70- K22.719 Barrett's esophagus code range
- Z13.810 Encounter for screening for upper gastrointestinal disorder
- Z13.811 Encounter for screening for lower gastrointestinal disorder
- Z13.83 Encounter for screening for respiratory disorder NEC

The interpretation and report of optical endomicroscopic image(s) would be reported with the following code: 88375: Optical endomicroscopic image(s), interpretation and report, real-time or referred, each endoscopic session.

Code 88375 cannot be reported in conjunction codes 43206 and 43252.

**Additional Policy Key Words**

N/A

**Policy Implementation/Update Information**

3/1/13 New policy; considered investigational.
9/1/13  No policy statement changes.
3/1/14  No policy statement changes.
3/1/15  No policy statement changes.
9/1/15  No policy statement changes.
3/1/16  Added Cat III CPT code. No policy statement changes.
9/1/16  No policy statement changes.
3/1/17  No policy statement changes.
9/1/17  No policy statement changes.

State and Federal mandates and health plan contract language, including specific provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage. The medical policies contained herein are for informational purposes. The medical policies do not constitute medical advice or medical care. Treating health care providers are independent contractors and are neither employees nor agents Blue KC and are solely responsible for diagnosis, treatment and medical advice. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, photocopying, or otherwise, without permission from Blue KC.