Endomicroscopy and Molecular Tools to Evaluate Inflammatory Bowel Disease

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KEYWORDS

• Confocal endomicroscopy • Colonoscopy • Ulcerative colitis • Crohn's disease
• Inflammatory assessment • Dysplasia • Molecular imaging

KEY POINTS

- Confocal laser endomicroscopy (CLE) is a rapidly emerging tool in endoscopic imaging allowing in vivo microscopy of examined gastrointestinal mucosa. CLE also has the potential to enhance the endoscopic evaluation of inflammatory bowel disease (IBD). This may be achieved by further characterization of otherwise normal-appearing mucosa, assessment of the barrier function of the epithelium, and characterization of any mucosal lesions including dysplastic lesions.
- Imaging of intestinal inflammation in IBD by CLE may be of special importance not just for the diagnosis of IBD, assessment of severity of inflammation but also for predicting severity and the guidance of therapy. This would represent a true advantage of CLE over the conventional white-light endoscopy in evaluation of IBD and assessment of a true mucosal healing.
- Advances in IBD may be used not only to better understand the pathophysiology of IBD but also to guide optimized therapy and thus allow a completely new, personalized approach to the IBD management.
- Further studies are needed to fully evaluate and validate the promising results of CLE studies in IBD.

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INTRODUCTION

Endoscopy is an essential tool in effective evaluation of patients with inflammatory bowel disease (IBD). The endoscopic evaluation of IBD includes not only diagnosing the disease, assessing the disease's extent and activity, but also treating its complications, monitoring the responses to treatment with evaluating mucosal healing, and serving as a predictor of disease course. The small-field endoscopic imaging technology, such as confocal laser endomicroscopy (CLE) has allowed real-time imaging of gastrointestinal mucosal during ongoing endoscopic evaluation in various gastrointestinal pathologies.[1–4] It also has the potential to enhance endoscopic evaluation in IBD. CLE is based on tissue illumination with a low-power laser allowing micron-level spatial resolution with ×1000 magnification. To obtain images, exogenous fluorescence contrast is applied with agents such as fluorescein (10% 5 mL solution, intravenous application), or acriflavine hydrochloride or cresyl violet (topical applications). Intravenous fluorescein (1.0–5.0 mL of 10% solution) distributes throughout the capillary network and connective matrix and has been universally applied in all confocal studies and is found to be generally safe in use.[5] Until recently, CLE has been performed using 1 of 2 Food and Drug Administration (FDA)-approved devices: endoscope-based confocal laser endomicroscopy (Pentax, Fort Wayne, NJ; herein termed eCLE) and a stand-alone probe CLE (herein termed pCLE) capable of passage through the accessory channel of most endoscopes (Cellvizio, Mauna Kea Technologies, Paris, France).[6] Currently the eCLE system is no longer clinically available, although most clinical applications have been studied based on that system.

The probe-based CLE system (pCLE), introduced in 2005, consists of a stand-alone confocal probe, capable of passage through an accessory channel of most endoscopes. The probe is made of 30,000 optical fibers bundled together with a distal lens and a proximal precision connector. The proximal connector attaches the probe to the laser scanning unit that is connected to a standard computer for image data processing and display (**Fig. 1**). **Table 1** lists the features of the 2 CLE systems: the current probe based and the prior endoscope based.

The value of CLE in evaluation of conditions such as Barrett esophagus, colorectal polyps, and celiac disease has been demonstrated and validated in various studies.[3,7–9] CLE also has the potential to enhance the endoscopic evaluation of IBD. This may be achieved by further characterization of the barrier function of the epithelium, assessment of inflammatory activity, characterization of any mucosal lesions, and ultimately predicting severity, disease extent, and response to the treatment.[10,11] Imaging of intestinal inflammation in IBD by CLE may be of special importance not just for the diagnosis of IBD but also for the guidance of therapy. Furthermore, advances in molecular in vivo imaging in IBD may be used to better understand the pathophysiology of IBD and to guide an optimized therapy.[12] This review discusses the most recent advances and potential applications of confocal endomicroscopy and molecular tools in the evaluation of IBD.

CONFOCAL LASER ENDOMICROSCOPY FOR ASSESSMENT OF INFLAMMATION, BARRIER FUNCTION OF EPITHELIUM, AND DISEASE RELAPSE

As the field of IBD therapy has moved to a "treat-to-target" approach, with the goal of suppressing microscopic inflammation, CLE may play an important role in assessing disease activity with detection of all inflammatory features, assessing the degree of inflammation as well as evaluating the barrier function of the epithelium.[10] CLE may also facilitate the distinction between ulcerative colitis (UC) and Crohn's disease (CD).[13]