Comparison of narrow-band imaging, volumetric laser endomicroscopy, and pathologic findings in Barrett’s esophagus

Chikatoshi Katada, MD,1 Rish K. Pai, MD,2 Norio Fukami, MD1

Volumetric laser endomicroscopy (VLE) (Ninepoint Medical, Bedford, Mass, USA) is a balloon-based second-generation optical coherence tomography technology that provides high-resolution esophageal imaging.1-4 The novel algorithm of computer-enhanced visualization (intelligent real-time image segmentation, IRIS) of VLE highlights features previously associated with suspected dysplasia, including hyperreflective tissue surface signal (pink) and hyporereflective cystic structures above the submucosal layer (blue). Additional features of loss of layers (typically seen in columnar epithelium such as in Barrett’s esophagus [BE] or gastric mucosa [orange]) and hyporeflective cystic structures below the layer can be overlaid on the VLE images with color.

A 36-year-old man was seen with a long history of GERD and known BE for 10 years. Examination of his most recent biopsy specimen showed well-differentiated adenocarcinoma arising in the background of intestinal metaplasia.

We used advanced imaging along with narrow-band imaging (NBI) with near-focus mode (GIF-HQ190; Olympus America, Pa, USA) and VLE with IRIS to delineate the extent of dysplasia and esophageal adenocarcinoma (EAC) occurring in BE.

The Barrett’s International NBI Group (BING) criteria can be used to predict the presence or absence of dysplasia in NBI images of BE with a high level of accuracy.5 The Barrett’s epithelium was carefully examined by the use of NBI with near-focus mode to classify the BING criteria.

High-resolution white-light endoscopy showed BE (Fig. 1). We identified abnormalities within the BE. The first was marked as site A on the left proximal side of the anterior wall within the nodularity. We noted site B on the distal side of the anterior wall with an irregular surface with depression.

Site A had mucosal irregularity with whitish exudate over the reddish mucosa, which bled easily (Fig. 2). Site B also had covering whitish exudate and reddish mucosa with depression. Mucosal irregularity was much more prominent (Fig. 3).

In the NBI endoscopic view, most of proximal side A had both an irregular mucosal pattern and an irregular vascular pattern according to the BING criteria (Fig. 4). Site B also had both an irregular mucosal pattern and an irregular vascular pattern according to the BING criteria (Fig. 5).

We performed in vivo VLE twice before resection, once after the NBI examination and again after thermal marking for ESD, from which the en face view and fly-through view were created immediately by computer algorithm. The VLE en face

Figure 1. High-resolution white-light endoscopy, sites A and B.

Figure 2. High-resolution white-light endoscopy, site A.
The VLE endoscopic fly-through view resembled the ex vivo specimen. The VLE endoscopic fly-through view resembled the endoscopic image. After NBI examination, a VLE image was obtained that could be shown as a fly-through view and an en face view for review. In the VLE endoscopic fly-through view, sites A and B had hyperreflective tissue surface signals shown in pink. Hyporeflective cystic structures in blue were seen in the middle of site A (Fig. 6). The abnormal VLE findings corresponded with the abnormal areas on NBI examination. No additional abnormal areas were seen on VLE outside of the NBI-guided planned resection. Then, thermal markings were made under guidance by the NBI examination. To confirm the marked area on the VLE image, a repeated scan was done to obtain VLE images that were then reviewed on the en face view.

Thermal markings were recognized in the VLE en face view as spots of hyperreflective tissue surface (pink). After thermal markings, the VLE sectional image was used to laser-mark the blue hyporeflective cystic structures within site A in a search for corresponding histopathologic features. We were able to correlate the markings on the resected specimen, indicated by the colored arrows (Fig. 7).
Macroscopic type was 0-IIa for site A and 0-IIa+IIc for site B. Sites A and B corresponded to adenocarcinoma on histopathologic examination. Adenocarcinoma with submucosal invasion was seen within site B. On VLE with IRIS image, a mixture of hyperreflective tissue surface signal within an abnormal glandular structure (pink within a group of blue spots) was seen on the proximal side within the right tongue of the BE. On histopathologic examination, intramucosal adenocarcinoma was seen at this site within high-grade dysplasia, which was suspected to be dysplastic but not cancerous on endoscopic inspection (Fig. 8).

The histopathologic diagnosis was well-differentiated adenocarcinoma with submucosal invasion. The invasion depth was 240 μm with no lymphovascular invasion, and the horizontal and vertical margins were negative (Fig. 9).

Areas where irregular mucosal patterns and irregular vascular patterns were recognized by NBI magnification were shown to be adenocarcinoma on histopathologic review. The majority of sites where a pink hyperreflective tissue surface signal was recognized in VLE with IRIS corresponded to the areas of adenocarcinoma. Although an irregular mucosal pattern and irregular vascular pattern were not seen in the area between sites A and B by the use of NBI, a pink hyperreflective tissue surface signal was seen on VLE with IRIS. This site was pathologically determined to be intramucosal adenocarcinoma. Normal cardia tends to show pink hyperreflective tissue; therefore, NBI appears to be superior to judge the neoplastic border in this area. The superiority of each modality in a specific situation and how those modalities should be used to complement one another to increase sensitivity and specificity should be clarified in future studies.

The initial NBI magnification evaluation showed 2 areas of distinctive abnormalities. The proximal site of the tongue of the BE on the right showed an irregularity of glands that was suggestive of high-grade dysplasia. Therefore, it was judged best to remove more than half of the circumference, including both tongues. VLE-IRIS showed both to be concerning for HGD cancer. In retrospect, a small area in the proximal site of the tongue of the BE on the right had a mixture of pink and blue, suggestive of worse pathologic changes than expected by NBI. Pathologic evaluation confirmed this site to be intramucosal adenocarcinoma. NBI and VLE appeared complementary in this case.

In the VLE sectional image, blue hyporeflective cystic structures corresponded to atypical glands of the subepithelial layer and pink hyperreflective surface to adenocarcinoma (Video 1, available online at www.VideoGIE.org).

Figure 8. Mapping on the resected specimen for sites A and B. NDBE, Nondysplastic Barrett’s esophagus; LGD, low-grade dysplasia; HGD, high-grade dysplasia; IMC, intramucosal cancer; SM Ca, submucosal cancer.

Figure 9. Histopathologic view showing well-differentiated adenocarcinoma with submucosal invasion (H & E, orig. mag. × 200).
A combined diagnosis by NBI and VLE may add value to a real-time localization of dysplasia and EAC occurring in BE. The relative value of each modality in terms of detecting dysplasia or confirming dysplasia in areas identified by the other modality will require careful future investigation.

**DISCLOSURE**

All authors disclosed no financial relationships relevant to this publication.

**REFERENCES**

1. Trindade AJ, Smith MS, Pleskow DK. The new kid on the block for advanced imaging in Barrett’s esophagus: a review of volumetric laser endomicroscopy. Therap Adv Gastroenterol 2016;9:408-16.

2. Wolfsen HC, Sharma P, Wallace MB, et al. Safety and feasibility of volumetric laser endomicroscopy in patients with Barrett’s esophagus. Gastrointest Endosc 2015;82:631-40.

3. Leggett CL, Gerospe EC, Chan DK, et al. Comparative diagnostic performance of volumetric laser endomicroscopy and confocal laser endomicroscopy in the detection of dysplasia associated with Barrett’s esophagus. Gastrointest Endosc 2016;83:880-8.

4. Swager A-F, Tearney GJ, Leggett CL, et al. Identification of volumetric laser endomicroscopy features predictive for early neoplasia in Barrett’s esophagus using high-quality histological correlation. Gastrointest Endosc 2016;85:918-26.

5. Sharma P, Bergman JJ, Goda K, et al. Development and validation of a classification system to identify high-grade dysplasia and esophageal adenocarcinoma in Barrett’s esophagus using narrow-band imaging. Gastroenterology 2016;150:591-8.