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Endoscopic microvascular patterns of gastrointestinal cancer

Toshihiro Nishizawa^{1, 2)} and Hidekazu Suzuki^{1), *}

1) Division of Gastroenterology and Hepatology, Department of Internal Medicine,
Keio University School of Medicine

2) Division of Gastroenterology, National Hospital Organization Tokyo Medical Center

Abstract

Magnifying endoscopy with narrow-band imaging (ME-NBI) enhances visualization of microcirculatory and micromucosal structures for a more detailed assessment of gastrointestinal cancer. The updated Japan esophageal society classification is simple and useful for diagnosing esophageal squamous cell cancer and the depth of invasion. In ME-NBI of gastric tumors, an irregular microvascular pattern and the presence of a demarcation line are characteristic signs of early gastric cancer. A relatively regular “fine network pattern” or an abundant microvessel “mesh pattern” is more likely observed in well-differentiated adenocarcinoma. Tortuous microvessels and a low-density microvessel “corkscrew pattern” are more likely observed in poorly differentiated adenocarcinoma. In ME-NBI of colonic tumors, the vague microvascular pattern is often observed in hyperplastic polyps. The regular meshed microvascular pattern is most frequently observed in adenomas. The irregular meshed microvascular pattern is often observed in intramucosal or relatively shallow submucosal invasive carcinomas. The irregular and loose microvascular pattern is often observed in deeply invasive submucosal carcinomas. [MVRC 6(1): 9-12, 2013]

Key words: narrow-band imaging, magnifying endoscopy, gastrointestinal cancer, microvascular pattern

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*To whom correspondence should be addressed: Dr. Hidekazu Suzuki, Division of Gastroenterology and Hepatology, Department of Internal Medicine, Keio University School of Medicine
35 Shinanomachi, Shinjuku, Tokyo, 160-8582, Japan
E-mail: hsuzuki@a6.keio.jp

Fig. 1. ME-NBI findings of normal esophageal mucosa and early esophageal cancer. (A) The normal intraepithelial papillary capillary loop (IPCL) was observed as brown vessel which is positioned in the most superficial layer and is derived upright from the branching vessel. Branching vessel which are located at the surface of muscularis mucosa were shown as a green vascular network. (B) Squamous cell carcinoma (T1a-EP) demonstrated irregular IPCL with composed by loop like vessels. (Japan esophageal society classification: type B1)

Introduction

Narrow-band imaging (NBI) is a new endoscopic visualization modality designed to enhance mucosal contrast without *in vivo* dye staining¹. NBI employs the use of special narrow-band filters that filter the broad-band spectrum and allow the narrow-band spectrum to pass through for the diagnosis of digestive tract diseases. Because the light of a shorter wavelength that is filtered through the special narrow-band filter cannot penetrate deeply into the mucosa, NBI improves the visibility of mucosal pit patterns. Since the specific wavelength (415 nm) filtered through the special narrow-band filter corresponds to the peak absorption spectrum for hemoglobin, NBI image magnification can provide reliable information about microvascular patterns.

The combination of magnifying endoscopy with NBI (ME-NBI) has been shown to enhance the visualization of microvascular and micromucosal structures in order to provide a more detailed assessment of early malignant lesions.

This review article summarizes ME-NBI microvascular patterns of early gastrointestinal malignancies.

Esophageal cancer

Superficial blood vessels in the esophageal mucosa comprise branching vessels and intraepithelial papillary capillary loops (IPCLs). IPCLs are tennis racket-shaped, dark brown capillaries in the mucosa that are derived from the side-branch blood vessels in the submucosal layer (Fig. 1A). Angiogenesis is well known to play a critical role in the transition from premalignant to malignant lesions. IPCLs demonstrate characteristic morphological changes in accordance with tissue atypism and the depth of cancer invasion. ME is useful for the diagnosis of squamous cell carcinoma and invasion depth. Although the Inoue classification² and Arima classification³ of IPCLs have been popular in Japan, both classifications are slightly complicated for beginners.

Therefore, the Japan esophageal society combined the 2 classifications and thus reported a new classification⁴. ME findings with regard to capillary patterns are classified into 2 groups: Type A (intraepithelial neoplasia), vessels with mild IPCL atypia and Type B (squamous cell carcinoma), IPCL atypia with dilatation, meandering, caliber changes, and uneven forms in each vessel (Fig. 1B). Type B was sub-classified into 3 groups, B1, B2, and B3. Types B1, B2, and B3 are characterized by loop-like vessels, non-loop vessels, and vessels more than 3-fold larger than B2 vessels, respectively. B1, B2, and B3 suggest depths of invasion of T1a-EP-LPM (B1), T1a-MM-T1b-SM1 (B2), and T1b-SM2 (B3), respectively.

The avascular area (AVA) was defined as an area without vessels or one with few vessels. AVAs were divided into 3 groups according to size. AVA-small, AVA-middle, and AVA-large were defined as 0.5 mm or less, between 0.5 and 3 mm, and 3 mm or larger. The AVAs suggest depths of invasion of T1a-EP-LPM (AVA-small), T1a-MM-T1b-SM1 (AVA-middle), and T1b-SM2 (AVA-large), respectively. However, in cases where the AVA comprised only B1 vessels, the depth of invasion was diagnosed as T1a-EP-LPM, regardless of size.

Gastric cancer

Differences in microvascular architecture, which can be observed by ME, are useful for differentiating between focally reddened mucosa with gastritis and reddened early gastric adenocarcinoma. In particular, the irregular microvascular pattern is the most useful finding in differential diagnosis of gastritis and cancer (Fig. 2). Yao et al. reported ME features of early gastric cancer by identifying irregular microvessels and a demarcation line between the lesion and surrounding mucosa⁵. They proposed a VS (vessel plus surface) classification based on the microvascular and micro-surface patterns and indicated that an irregular microvascular pattern and/or an irregular microsurface pattern together with

Fig. 2. ME-NBI findings of normal gastric mucosa and early gastric cancer. (A) The normal pattern of corpus mucosa was characterized by a regular arrangement of small, round pits surrounded by a subepithelial capillary network (brown rings). (B1) Well-differentiated adenocarcinoma demonstrated irregular microvascular architecture: dilatation, tortuous running and caliber changes. (B2) There was a clear demarcation line between the background mucosa and the cancer (arrows).

Fig. 3. ME-NBI findings of normal colonic mucosa and early colonic cancer. (A) The normal pattern was characterized by a regular meshed arrangement of the microvessels surrounding the pits. (B) Well-differentiated adenocarcinoma demonstrated irregular capillary vessels. (Sano classification type IIIA)

a clear demarcation line are characteristic of early gastric cancer. Based on this VS classification, several studies have achieved good outcomes with ME-NBI. ME-NBI could be useful for the differential diagnosis of early gastric cancer subtypes. A relatively regular “fine network pattern” or abundant microvessel “mesh pattern” is more likely observed in well-differentiated adenocarcinomas. Tortuous microvessels and a low-density microvessel “corkscrew pattern” are more likely observed in poorly-differentiated adenocarcinomas⁶.

Submucosal invasion might not be reflected at the mucosal surface in early gastric cancers, and its usefulness

in measuring the depth of gastric cancer invasion remains to be verified⁷.

Colon cancer

Sano et al. reported that ME is useful for the differential diagnosis of non-adenomatous lesions, adenoma, and carcinoma⁸. The Sano classification is based on the evaluation of the microvascular architecture on lesion surfaces⁹. The capillary patterns were classified as type I, II, IIIA, or IIIB. Type I is characterized by a visually unidentifiable mesh of capillary vessels. Type II is characterized by a mesh of capillary

vessels. Mucosal lesions with Type I and II vessels strongly suggest hyperplastic polyps and adenoma, respectively. Type III is most frequently observed in carcinoma and is characterized by a mesh of capillary vessels with a blind ending, branching, and irregular curtailing (Fig. 3). Type III is divided into 2 subtypes¹⁰. Type IIIA is characterized by high microvessel density with a lack of uniformity, and type IIIB is characterized by the presence of an area with nearly avascular or sparse microvascular findings. Types IIIA and IIIB suggest depths of invasion of intramucosal–shallow SM and deep SM, respectively.

Conclusion

ME-NBI is expected to be very useful in accurate diagnosis and clear visualization of the microvascular structures. Angiogenesis is known to be an important factor in gastrointestinal carcinogenesis; this suggests that the vascular patterns of cancer and precancerous lesions differ from those of normal mucosa^{11–13}. Therefore, observation of the vascular pattern contributes to cancer diagnosis and estimation of the depth of invasion and histology subtypes in endoscopically accessible digestive tracts.

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