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Is Image-Enhanced Endoscopy Useful for the Diagnosis and Treatment of Gastrointestinal Tumor?

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Since the introduction of endoscopic submucosal dissection method for the treatment of early gastric cancer, endoscopic treatment of early gastric cancer has increased exponentially. Accordingly, early diagnosis of cancerous or precancerous lesion has become one of the most important missions for endoscopists. The desire to improve diagnostic capability of white light endoscopy led to the development of new imaging techniques called "image enhanced endoscopy." The usefulness of these image enhanced endoscopy has not been proven yet, although there are several studies reporting diagnostic superiority of these new imaging methods over white light endoscopy. Among these new imaging modalities, narrow band image (NBI) with magnification endoscopy has been most widely used and studied. This manuscript will be focused on the NBI with magnification endoscopy.

Key Words: Image enhanced endoscopy; Stomach neoplasms; Diagnosis

INTRODUCTION

Thanks to the development in endoscopes and endoscopic techniques, a significant number of stomach cancer patients undergo endoscopic resection rather than surgery. In addition, the National Cancer Screening Program has increased the number of diagnosing early gastric cancer, and accordingly, the frequency of endoscopic treatment has become equal or larger than that of surgical treatment. Early detection of stomach cancer and precancerous lesion is becoming more and more important these days.

Although endoscopy is the most definitive method of detecting early gastric cancer or precancerous lesion among various diagnostic tools, not all the lesions are confirmed through endoscopy due to the confusions in the shape and size of the lesions, or the intestinal metaplasia of the surrounding tissues in spite of the endoscopists' best efforts to find anomalies. To overcome the limitations of the white light endoscopy, and to

enhance the diagnostic rate, image-enhanced endoscopies (IEEs) with various optical and electronic methods have been developed and used. Types of IEEs include narrow band image (NBI), autofluorescence image (AFI), flexible spectral imaging color enhancement (FICE), i-scan, and confocal endomicroscopy. According to the previous studies on IEE, the diagnostic rate and the diagnostic accuracy of cancer and precancerous lesion have increased. Nevertheless, these studies that were mostly reported in Japan used different diagnostic criteria from each other, so their results are not fully reliable.

NBI WITH OR WITHOUT MAGNIFICATION

When light is passed through the tissues, the penetration depth is proportional to the wavelength of the light. Accordingly, when short wavelength visible light such as blue light is projected onto the surface of the tissues or mucous membrane, they are clearly observed. It is not certain whether the use of NBI-only in observing the mucosal lesion has more advantage than the use of chromoscopy, but a combined use of NBI with magnifying endoscopy has a definite advantage in observing the microstructure and the microvasculature of the mucosal surface. Practically most studies that reported favorable results in the diagnoses of lesions used both NBI and magnifying endoscopy rather than white light endoscopy or

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chromoscopy.¹⁻⁴

Esophagus

Barrett's esophagus

Since the prevalence of Barrett's esophagus and associated esophageal cancer is high in Western countries, many studies have been conducted on the methods of enhancing the diagnostic accuracy of Barrett's esophagus. In those studies, a combined use of magnification endoscopy with NBI resulted in a higher sensitivity and specificity than the use of white light endoscopy or chromoscopy. Nevertheless, the most significant limitation of these studies was that they were not based on standardized diagnostic criteria.

In case of large intestine, the pit pattern of the mucosal surface is generally classified according to the Kudo's classification, whereas the classification of upper gastrointestinal microsurface structure has not been standardized.

In case of Barrett's esophagus, the methods of classifying the pit pattern of the mucosal surface have not been unified yet. However, the methods include Guelrud classification (i.e., round pits, reticular pits, villous, and ridged), Endo classification, Kara classification, Sharma classification, and Anagnostopoulos classification.⁵⁻⁸

Esophageal cancer

Since the esophageal mucosa is covered with squamous epithelium, mucosal pits are not observed, and accordingly, it is necessary to observe its microvascular structures. When the esophageal mucosal surface is observed through magnifying endoscopy, dark brown capillaries in a shape of a tennis racket are found. This vascular structure is called intraepithelial papillary capillary loops (IPCLs), and their shapes are decided according to the level of tissue dysplasia and the depth of tumor invasion. Inoue et al.⁹ classified IPCLs into five types according to their dilatation, tortuosity, irregular caliber, and form variation. Inoue's classification system helps predict the depth of tumor invasion in esophageal cancer on endoscopy, but the accuracy of this method is still not satisfactory compared with other diagnostic methods such as endoscopic ultrasound (EUS). Arima et al.¹⁰ suggested a method of classifying the patterns of IPCLs into four types. In the meantime, no method has been proved to be most accurate among others, so a new classification method that concludes the strengths of various methods is necessary now.

Stomach

Since the stomach has a wide lumen, and the light source of NBI is weak, the use of NBI without magnifying endoscopy in observing the microsurface structures of the stomach may

result in a poor accuracy in diagnosis due to the dark and low endoscopic resolution. Therefore, magnifying endoscopy should be used in combination with NBI for observing the microsurface structures of the stomach.

Regarding the classification of the pit patterns of gastric mucosa, the method of Sakaki et al.,¹¹ which was suggested in 1978, has been used in some cases. With the introduction of NBI, several authors including Yao et al.¹² suggested various classification methods based on the microsurface and the microvascular structures,¹²⁻¹⁴ but no consensus on the diagnostic criteria has been established yet.

Since the prevalence of stomach cancer is very high in Korea, and early gastric cancer can be treated with endoscopic resection, early diagnoses, and the decision of the indication for endoscopic resection has been a major mission of endoscopists. Another important mission of endoscopists is determining precisely the margin of the lesion in endoscopic resection in order to achieve a complete resection.

The depth of tumor invasion is the most important factor in determining the indication of endoscopic resection. Some studies reported that specific types of gastric microsurface and microvascular structures can help predict the depth of tumor invasion, but the accuracy of this method was confirmed to be not superior to that of EUS test.

In endoscopic resection for early gastric cancer, an exact identification of its margin as well as that of the depth of tumor invasion is very important for a complete resection. According to Yao et al.,¹² the findings of gastric cancerous lesions obtained by NBI with magnifying endoscopy include a loss of regular subepithelial capillary network, the presence of irregular microvascular pattern, and the presence of demarcation line that differentiates the lesion from the normal tissues. Most recent studies have reported that the observation of these findings in magnifying endoscopy with NBI can more effectively help determine the exact margin of the lesions compared with the white light endoscopy. Practically the margin of the lesions can often be determined with the typical methods such as white light endoscopy and chromoscopy, and the margin is hardly determined only in the cases of severe intestinal metaplasia of the surrounding tissues. Therefore, considering the time and cost for the tests, the utility of NBI is questionable.

OTHER IMAGE ENHANCED ENDOSCOPY: AUTOFLUORESCENCE IMAGING, I-SCAN, FICE, AND CONFOCAL ENDOMICROSCOPY

These image-enhanced methods of endoscopy have been developed more recently than NBI, so fewer studies have been conducted than on NBI. Moreover, other than the studies on

confocal endomicroscopy, the utility of the most studies that have been conducted by Japanese authors is uncertain. Even though there is no consensus on the combined use of magnifying endoscopy with NBI, there are diagnostic criteria that have been developed by many authors. In comparison, no diagnostic criteria have been established yet for AFI, i-scan, FICE, and confocal endomicroscopy.

Confocal endomicroscopy is an imaging technique, which was developed most recently, and the images can be magnified up to $\times 1,000$. The images of the lesions are seen like microscopic views, so this method is called virtual biopsy. Many studies on confocal endomicroscopy are under way in the world including Western countries. Nevertheless, no exact diagnostic criteria have been established yet. In addition, much experience is required to interpret the findings, and the low interobserver reliability is another limitation.

CONCLUSIONS

With the development in endoscopic devices, the diagnostic and therapeutic techniques are also rapidly developing now. Many studies on NBI and various IEEs have been conducted to confirm whether these techniques can contribute to the improvement in endoscopic diagnoses and treatments or not. Although these new imaging techniques are expected to enhance the quality of the endoscopic diagnoses and treatments, there are some drawbacks to be overcome.

The diagnostic criteria that are based on the findings of image-enhanced endoscopy such as NBI have been developed in a specific country, and the studies on their utility have been conducted by a limited number of groups. This is the reason why previous studies on the image enhanced endoscopy are not reliable. Therefore, standardized diagnostic criteria should be established based on the consensus meeting for these new image-enhanced techniques. Another limitation is that the interpretations of the observers on the findings of IEE do not coincide, so the interobserver reliability is low. To improve the interobserver reliability, standardized diagnostic criteria should be established through sufficient discussions and trainings.

When the aforementioned limitations are overcome, the new image-enhancement techniques may contribute to the

development of diagnoses and treatments of the lesions. Further studies may be necessary to do so.

Conflicts of Interest

The authors have no financial conflicts of interest.

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