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Diagnostic ability of blue laser imaging combined with magnifying endoscopy for early esophageal cancer

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ABSTRACT

Background: Blue laser imaging (BLI) is a new image-enhanced endoscopy technique that utilizes a laser light source developed for narrow-band light observation.
Aims: To evaluate the value of BLI combined with magnifying endoscopy (M-BLI) for the diagnosis of early esophageal cancers (EECs).
Methods: This single-center prospective study analyzed 149 patients with focal esophageal lesions detected with white light endoscopy (WLE) at Renmin Hospital of Wuhan University between April 2015 and June 2017. In this study, patients were examined sequentially with narrow-band imaging combined with magnifying endoscopy (M-NBI), M-BLI and 1.25% Lugol's iodine chromoendoscopy. The concordance between endoscopic diagnosis and pathological diagnosis was evaluated using the agreement (kappa) test. The paired chi-square test was used to compare the concordance of M-NBI, M-BLI and Lugol's iodine chromoendoscopy.
Results: This study analyzed 153 lesions (four patients had two lesions each). The sensitivity, specificity, accuracy, concordance rates and kappa value of M-BLI were 95.2%, 91.9%, 85.7%, 92.8% and 0.891, respectively; those of M-NBI were 95.2%, 92.8%, 87.5%, 93.5% and 0.906; and those of Lugol's iodine chromoendoscopy were 95.2%, 94.6%, 91.3%, 94.8% and 0.936.
Conclusion: M-BLI has a diagnostic profile similar to that of M-NBI and could improve the accuracy of EEC diagnosis.

1. Introduction

Esophageal cancer is one of the most common malignant gastroenterological cancers in China, and ranks fifth and fourth among cancers in morbidity and mortality, respectively [1]. Early detection, diagnosis and treatment have significantly improved the prognosis and survival rate of patients with esophageal cancer. However, it is often easy to miss early esophageal cancer (EEC) using conventional white light endoscopy (WLE), and it can be difficult to make a correct diagnosis. Recently, blue laser imaging (BLI), developed by Fujifilm, has offered a new clinical approach for the diagnosis of EEC. BLI combined with magnifying endoscopy (M-BLI) has the potential to diagnose EEC as efficiently as narrow-band imaging combined with magnifying endoscopy (M-NBI) because it also uses narrow-band laser light combined with illumination light. However, sufficient data have not been reported regarding its diagnostic performance for EEC. Therefore, we aimed to investigate the use of M-BLI in the diagnosis of EEC by comparing endoscopic diagnosis using WLE, M-BLI, M-NBI and Lugol's iodine chromoendoscopy.

2. Patients and methods

2.1. Patients

A prospective single-center study was conducted at the Department of Gastroenterology, Renmin Hospital of Wuhan University. A total of 149 consecutive patients were enrolled in this study. Between April 2015 and June 2017, these patients underwent WLE at our hospital because of chest pain, dysphagia, regurgitation, heartburn, abdominal discomfort and other upper digestive tract systems, and abnormal changes in their esophageal mucosa

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color and (or) structure were found. The day after the WLE procedure, these patients provided written informed consent to undergo gastroendoscopy with M-NBI, M-BLI and Lugol's iodine chromoendoscopy. Specimens of all lesions were obtained by biopsy.

This study was approved by the Ethical Review Committee of Renmin Hospital of Wuhan University and conducted in accordance with the Helsinki Declaration of the World Medical Association.

2.2. Endoscopic system and device

All procedures were sequentially performed with optical EVIS LUCERA CV-290 endoscopes (OLYMPUS), LASEREO EG-L590ZW endoscopes (Fujifilm) and 1.25% Lugol's iodine chromoendoscopy. In the NBI and BLI mode, to easily obtain magnified endoscopic images of the lesions, we attached a soft black attachment to the tip of the scope.

2.3. Diagnostic criteria

The endoscopic diagnostic criteria for lesions when M-NBI and M-BLI were used were based on the Japan Esophageal Society (JES) classification of AB types according to the presence of an intraepithelial papillary capillary loop (IPCL) [2,3]. In this study, type A was defined as non-cancerous lesions, and type B (B1–B3) was defined as cancerous lesions.

The endoscopic diagnostic criteria for lesions when Lugol's iodine chromoendoscopy was used were based on the classification described in the consensus on the screening, diagnosis and treatment of early squamous cell carcinoma and precancerous lesions in China (Beijing 2015). In this consensus, grade I refers to mucous membranes that appear more brown than the normal esophagus; grade II refers to normal mucous membranes; grade III refers to less-brown mucous membranes, which are more common in cases of low-grade intraepithelial neoplasia (LGIN) or acute or chronic inflammation; and grade IV refers to Lugol-voiding mucous membranes, which are more common in cases of invasive carcinoma, early cancer and high-grade intraepithelial neoplasia (HGIN). Therefore, in this study, grades I–III lesions were defined as non-cancerous, and grade IV lesions were defined as cancerous.

The pathological diagnosis criteria were based on the revised Vienna classification of gastrointestinal epithelial neoplasias [4]. Precancerous lesions included LGIN and HGIN, but most scholars believe that LGIN has an unclear prognosis; 29.6% of LGIN cases progress to HGIN or squamous cell carcinoma, and EEC and HGIN represent a similar disease stage, so both EEC and HGIN were considered end events [5]. In this study, according to relevant literature [4–8], LGIN(C3) was defined as non-cancerous lesions, and HGIN(C4) was defined as cancerous lesions.

2.4. Endoscopic examination

A total of 149 patients were enrolled, and 153 lesions were found under WLE. All patients were treated with intravenous injection of scopolamine, 20 mg, and oral solution to remove foam and mucus, 50 ml. Half the patients underwent the following procedure: First, M-NBI was performed to observe the morphology and border of the lesions, color differences between the lesions and surrounding normal areas and the IPCL of the lesions. Next, the lesions were observed using the white mode of M-BLI, followed by LCI, BLI-bright and BLI-contrast, and the four BLI modes combined with magnification sequentially to determine morphological changes in the mucosal microvasculature (IPCL) in the diseased areas. The microvascular morphology type was determined according to the contrast between the lesions and surrounding normal areas. Finally, all the lesions were observed using Lugol's iodine chromoendoscopy. The other half of the patients underwent M-BLI first, followed by M-NBI and finally Lugol's iodine chromoendoscopy. After all the endoscopic examinations were performed, four forceps biopsy specimens were taken from each lesion.

Table 1
Clinicopathological characteristics of enrolled patients.

Number	149
Gender	
Male	87
Female	62
Median age, years (range)	62 (40–76)
Symptom	
Regurgitation or (and) heartburn	64
Chest pain	47
Dysphagia	3
Others	35

The endoscopic diagnosis was performed by 2 doctors with extensive experience in endoscopic diagnosis and were completely blind to the pathological findings of the biopsies, ESD specimens or surgical specimens. After consultation and consensus, endoscopic diagnoses were obtained. The pathological diagnoses were completed by two highly experienced clinical pathologists who were blind to the actual endoscopic findings. If the pathological diagnosis suggested HGIN or EEC, EUS and CT were performed. The lesions were resected by endoscopic submucosal dissection (ESD) or surgery. All the patients were followed for one year.

2.5. Statistical analysis

All statistical analyses were performed using SPSS version 16.0. Enumerated data were expressed in terms of sample size or rate (%). The kappa consistency test was used to evaluate the consistency between the endoscopic diagnoses with M-NBI, M-BLI, Lugol's iodine chromoendoscopy and the pathological diagnosis. The chi-square test was used to analyze the consistency between M-NBI and M-BLI and between M-BLI and Lugol's iodine chromoendoscopy. A p value less than 0.05 was considered statistically significant.

3. Results

1. Between April 2015 and June 2017, 149 consecutive patients were enrolled in this study, and 153 lesions were found. The patients comprised 87 males and 62 females; their age range was 40–76 years, and the mean age was 62 years. Four patients had two lesions each (Table 1).
2. Pathological diagnosis: A total of 111 cases had a pathological diagnosis of esophagitis, chronic mucosal inflammation or LGIN and were followed up. Forty-two patients with a pathological diagnosis of HGIN or early cancer were examined by EUS and CT. Three patients underwent surgical treatment because of lymph node metastasis. The remaining 39 patients underwent ESD (Table 2).
3. Comparison of the diagnostic accuracy of WLE, M-NBI, M-BLI and Lugol's iodine chromoendoscopy: Compared with WLE, the boundary between the lesions and the surrounding normal areas was more clear under NBI, BLI and Lugol's iodine chromoendoscopy (Fig. 1). The lesions found under WLE were all detected with NBI, BLI and Lugol's iodine chromoendoscopy. The diagnostic accuracy of WLE, NBI, BLI and Lugol's iodine chromoendoscopy for EEC was 56.0% (42/75), 87.5% (42/48), 85.7 (42/49), and 91.3% (42/46), respectively. The diagnostic rate of M-BLI was significantly higher than that of WLE (85.7% vs. 56.0%). However, the diagnostic difference between BLI and NBI was not statistically significant ($P = 0.902 > 0.05$). The diagnostic differ-

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