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Narrow-Band Imaging Endoscopy for Diagnosis of Malignant and Premalignant Gastrointestinal Lesions

KEYWORDS: Narrow-band imaging (NBI) - endoscopy with magnification - malignant/premalignant lesions

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ABSTRACT *Narrow-band imaging (NBI) is a novel endoscopic technique that may enhance the accuracy of diagnosis by using narrow-bandwidth filters in a red-green-blue (R/G/B) sequential illumination system. Magnifying endoscopy by using NBI has two distinct applications: the analysis of the surface architecture of the epithelium (pit pattern) and the analysis of the vascular network. This new technique allows a better characterization of distinct types of gastrointestinal epithelia (e.g. intestinal metaplasia in Barret's esophagus), as well as the disorganization of the vascular pattern in inflammatory disorders and the irregular pit pattern in early neoplastic lesions of the esophagus, stomach and large bowel.*

Introduction

Narrow band imaging (NBI) represents an advanced endoscopic technique consisting in the assessment of surface patterns and microvascular architecture by utilization of a narrowed spectrum light. Blue and green wavelengths are selected by optical filters, with the elimination of red light. These lights with nar- rowed bandwidths penetrate the superficial mucosal structures and are better absorbed by hemoglobin, providing an enhancement of mucosal features and blood vessels (capillaries from superficial mucosal layer, deeper mucosal and submucosal vessels[1]. It has been postulated that NBI may lead to the same contrast enhancement capabilities as chromoendoscopy, but without the toil of using dye agents[2]. The depth of penetration into the mucosa depends on the wavelength used – superficial for the blue band, deep for the red band and intermediate for the green band; the blue filter is designed to correspond to the peak absorption spectrum of hemoglobin to emphasize the image of capillary vessels on surface mucosa [3]. Magnifing endoscopy by using NBI has two distinct applications: the analysis of the surface architecture of the epithelium (pit pattern) and the analysis of the vascular network[4] .NBI may demonstrate the disorganization of the pit pattern and vascular pattern of the gastrointestinal mucosa in inflammatory and neoplastic (premalignant and malignant) lesions of the esophagus, stomach and large bowel. Interpretation of the surface pit pattern with magnification is easier in the large bowel than in the stomach because of gastric inflammation associated with the high prevalence of Helicobacter pylori [5]. The potential for submucosal invasion and lateral spread in differentiated early gastric cancer. (D-EGC) is an important consideration for this malignancy, as SM invasion is associated with the risk of lymphnode metastasis and lateral spread is associated with the risk of recurrence and residual disease after endoscopic and surgical resection [6]. In the large bowel mucosa, distinct types of pit patterns have been described for normal mucosa and for non-neoplastic and neoplastic lesions [7]. In the esophagus, endoscopy with magnification and NBI shows the microarchitecture of the columnar epithelium with depressions called pits or grooves, and elevations called crests or ridges. The main usefulness of this technique is to identify and target biopsies to areas of intestinal metaplasia, dysplasia and carcinoma[8,9].

Methods

To examine the patients, a digital video endoscope system EVIS EXERA-II (OLMPUS, Japan) with a gastroduodenoscope GIF-H180, colonoscope CF-H180AL as used. Targeted biopsy was performed according to the images obtained using the NBI-system.

The final diagnosis (conclusion drawn from the character of the chronic disease) was based on the results of the morphological studies. Statistical data processing was performed using the Statistica-6 (StatSoft, USA) program, including the Spearman rank correlation method.

Results

In this study, we examined 2166 patients with various chronic disorders of the gastrointestinal tract. The patients were divided into two groups: 1151 – who were subjected to NBI (the observation group) and 1015 – who were subjected to standard endoscopy without NBI (the comparison group). The observation group included 631 women and 520 men from 16to 85 years; mean age - 39.6±13.8 years. The comparison group included 481 women and 534 men, age between 18 and 74 years; mean age – 42.6±12.8 years. The following methods were performed in the observation group: esophagogastroduodenoscopy (EGD) was done in 989patients, colonoscopy (CS) in 162 patients. In keeping with the character of the pathology identified during the endoscopy, the patients in the observation group were divided as follows: those detected with symptoms of gastoesophageal reflux disease (GERD) and reflux esophagitis were 468 (47.3%) out of 989 patients, and those with chronic superficial gastritis, 742 patients (75.0%); those having atrophic gastritis were 114 patients (11.5%), while those showing chronic erosive gastritis (unspecified, ICD-X) included 133 patients (13.4%). Peptic ulcer was diagnosed in 159 patients (16.1%) out of the 989 observed: defects were found localized in the stomach in 67 patients (42.1%), in the duodenum in 77 patients (48.4%), and in the stomach and duodenum in15 patients (9.4%). The symptoms of chronic superficial colitis were detected in 143 patients (88.3%) out of 162, chronic atrophic colitis in 13 patients (8.0%), and ulcerative-necrotic changes of varying degrees of severity in the mucous membrane in 6 patients (3.7%). In the comparison or control group, the following results were obtained; symptoms of GERD

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with reflux esophagitis were detected in 15.0% patients, chronic superficial gastritis was identified in 3.1% patients, and chronic erosive gastritis (unspecified, ICD-X) in 14.9% patients. Peptic ulcer was diagnosed in 3.7% of the observed: defects were seen localized in the stomach, in 61.3% patients, in the duodenum in 32.3% patients, and in the stomach and duodenum in 6.5%. symptoms of chronic superficial colitis were detected in 94.9% patients, chronic atrophic colitis in 4.5% patients, and solitary colonic ulcer in one patient (0.6%). When we compared the data from the endoscopic examinations done in the observation and control groups, we suggested that the discolouration of the organ's mucus (glow in the reflected light) depended on the presence and severity of the inflammation. Inflammation is known to be accompanied by an increase in the hyperemia of the blood vessels. Therefore, the examinations of the patients using NBI were found to have had minimal signs of inflammation twice as often more than patients with similar changes in the comparison group (37.5% and 16.9%, respectively, $p<0.001$). The number of patients with severe symptoms of inflammation in the observation group was significantly less than in the comparison group (7.6% and 38.2%, respectively, $p<0.001$). The difference in the number of patients showing moderately severe inflammatory changes in both groups (54.9% and 44.95, respectively, $p<0.001$) did not exceed the limits of statistical error (no more than 10%, $p>0.050$. Sensitivity was 98.85%, with a specificity of 79.0%. By using NBI we detected foci of destruction and ulcerative changes in stages of incomplete epithelialization, which are normally difficult to visualize using the standard illumination method (Fig 1-2).

During statistical processing of data, a correlation between the severity of inflammation, the endoscopic imaging in NBI, and morphological studies was done. Correlation analysis of the dependence of the color change of the stomach mucosa during NBI with the gastritis type, presence of inflammation, metaplasia and Helicobacter pylori (Hp) contamination (Table 1) has revealed the presence of high correlation ($r>0.8$) between the metaplasia and type of gastritis, as well as the metaplasia and the blue glow of the mucosa ($r>0.7$). the degree of correlation between the symptoms of "the type of illumination in NBI" and "the severity of inflammation and Hp contamination ($r=0.54$). However, no correlation between Hp contamination with the type of luminescence of the gastric mucosa in NBI-mode, as well as the type of gastritis with metaplasia was established ($r<0.2$). A significant association of Hp contamination with the inflammation ($p<0.01$) and a moderate correlation between features ($r>0.5$) was noted. Inaddition, an inverse correlation between the presence of metaplasia and Hp contamination ($r<-0.2$) was noted, as well as a correlation between Hp contamination and the type of gastritis ($r<-0.2$).

Discussion

Digital video endoscopy with the NBI- system improves visualization of the surface structural changes in the mucosa in patients with inflammatory and destructive disorders[10-14]. Changing the color mode during the transition from standard to NBI endoscopy substantially changes the imaging, enhancing the ability to visualize the foci of inflammation, destruction and areas with structural changes. The vast improvement in the diagnosis of the minimal signs of inflammation was noted, as well as an increase in the dtetection of the destructive changes. Sensitivity and specificity of the examination of various parts of the gastrointestinal tract have accounted for 99.85% and 79.0% respectively. A comparison of the results of the endoscopic examination in standard and NBI- modes of various parts of the gastrointestinal tract has indicated an appreciable improvement in the diagnosis of chronic inflammatory diseases. The NBI system allows the detection of previously difficult differentiable inflammatory and destructive changes. Thus, the use of NBI endoscopy has greatly improved the detection of chronic inflammatory and destructive changes in the organs of the digestive system. Examination in the NBI made visualization possible, not only of the areas of inflammation, but also a demarcation of the zone of inflammation. This allows for a more accurate and purposeful determination of which areas are best to biopsy for subsequent morphological studies, and what factors significantly increase their diagnostic significance. Therefore, the results obtained have indicated that this imaging system with its high diagnostic and prognostic significance can be used to great advantage for the diagnosis of chronic diseases of the gastrointestinal tract.

Table 1
Values of Spearman's rank correlation coefficients

Examinations (n=969)	Endoscopy without NBI	NBI lilac glow	NBI blue glow	Type of gastritis	Inflammation	Hp contamination	Metaplasia
Endoscopy without NBI	-	-0,045	0,182	0,006	0,017	-0,006	0,005
NBI lilac glow	-0,045	-	***-0,814***	***-0,500***	-0,006	0,175	***-0,601***
NBI blue glow	0,182	***-0,814***	-	***0,619***	0,103	-0,198	***0,735***
Type of gastritis	0,006	***-0,500***	***0,619***	-	0,109	-0,244	***0,835***
Inflammation	0,017	-0,006	0,103	0,109	-	***0,539***	0,133
Hp contamination	-0,006	0,175	-0,198	-0,244	***0,539***	-	-0,181
Metaplasia	0,005	***-0,601***	***0,735***	***0,835***	0,133	-0,181	-

Note: Coefficients in bold are statistically significant

Fig 1 :

- Examination in standard endoscopy. The zone of inflammation with blurred vascular pattern.
- Examination in NBI. The inflammation zone with moderate blue-green glow; slit-like defect covered with a slight touch of fibrin is clearly visualized.

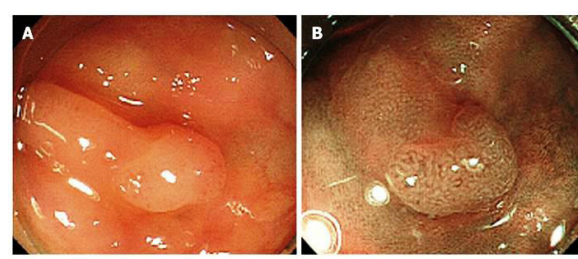
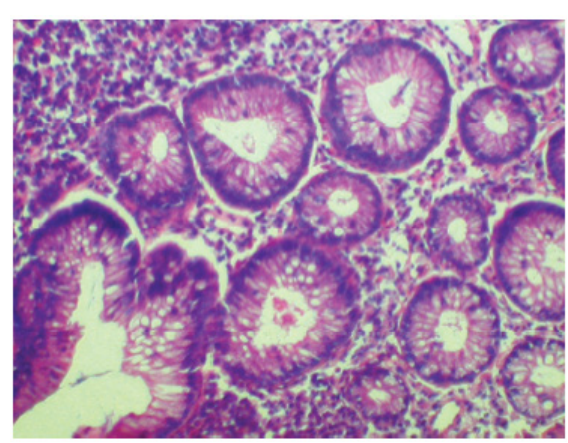


Fig 2 :
Morphological appearance (hematoxlin-eosin; x800)



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