

## Contribution of the Narrow Band Imaging to the Diagnosis of Esophageal Diseases

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### Abstract

**Introduction:** Conventional white light endoscopy uses the whole visible spectrum (400 - 700 nm). The Narrow Band Imaging (NBI) filters only part of the light spectrum and subsequently increases the intensity of blue light. The result is a more detailed microvascular image of the tissue due to the preferential absorption of blue light by the hemoglobin. This new technology has been developed by Japanese researchers. It aims to the detection and characterization of dysplastic lesions of gastrointestinal tract. Our study aimed to assess the improvement brought by this new technology in the diagnosis of esophageal diseases.

**Materials and Methods:** It was a prospective descriptive and analytical study. The patients were recruited in the digestive endoscopy unit of the General Aboubacar Sangoule Lamizana military Hospital in Burkina Faso. The endoscopy was implemented by a senior endoscopist performing first the traditional endoscopy with white light followed by the NBI endoscopy. The process was recorded and then displayed for interpretation to two different senior endoscopists. The correlation coefficient “kappa” was calculated for both endoscopists.

**Results:** Seventy patients were included. The mean age was 37.5 years with a range from 16 to 76 years. The sex ratio was 1.5. General practitioners prescribed 57.2% of the endoscopies with epigastralgia as the first indication (82%). The abnormal results rates for the white light and the NBI system were 32.9% and 39.5% respectively. The first esophageal pathology was hiatal hernia (20%). The cases of reflux esophagitis and Barrett’s esophagus increased with the NBI method. The correlation coefficient “kappa” for white light and NBI endoscopy was 0.5 and 0.67 respectively.

**Conclusion:** NBI endoscopy performed better than conventional endoscopy in diagnosing reflux esophagitis and doubtful Barrett’s esophagus. Inter-observer agreement was improved.

**Keywords:** Endoscopy; Narrow Band Imaging; Esophagus Diseases; Sub Saharan Africa

### Introduction

Most endoscopy procedures use the white light system. In spite of the better quality of pictures which resolution was improved these recent years the conventional endoscopy with white light remains limited by difficulties to detect for example the flat dysplasia areas inside the Barrett's esophagus or the chronic inflammatory intestines diseases. The limits include also the difficulty to characterize with accuracy the digestive mucous membrane [1-3].

This situation prompted the use of new technologies including virtual and electronic coloration called electronic chromo endoscopy in addition to the traditional techniques of coloration with lugol, indigo carmine or methylene blue. Different methods can be enumerated including the Narrow Band Imaging (NBI), the Fuji intelligent Color Enhancement (FICE) and the I scan (Pentax) [3,4].

The NBI is based on an optical filter at the light source that narrows the light band into two spectrums of around 115 nanometers (nm) and 540 nm. This process enhances the visualization of the superficial capillaries, the under-mucous as well as the mucosal surface vessels. At the opposite of the NBI, the FICE and the i-scan do not filter the white light at its origin. Instead these techniques alter the final pictures with an image processor system by selecting specific wavelengths. The FICE enhances the contrasts, the mucous membrane reliefs and the visualization of the capillaries.

The Pentax-developed i-scan displays two modes that can be used separately or together and including 1) the surface-enhancement i-scan that intensifies the contrasts in the mucous membrane allowing a better detection of the flat lesions and 2) the tone enhancement i-scan which processes the image by disaggregating the picture into primary colors and selecting a specific wavelength inside each component [4].

Although it is probable that new electronic chromo endoscopy techniques present more performance compared to traditional endoscopy with white light, an assessment of diagnosis accuracy of these techniques is necessary to recommend their use in routine practice.

### Aim of the Study

This study aims at comparing the accuracy of NBI against the traditional endoscopy with white light in diagnosing esophageal diseases.

### Materials and Methods

It was a prospective descriptive and analytical study implemented from the 3<sup>rd</sup> of March till the 11<sup>th</sup> of May 2015 in the digestive endoscopy unit of General Aboubacar Sangoule Lamizana military Hospital in Burkina Faso.

We collected socio-demographic and clinical data using a paper-based data collection form. The main variables include the profile of the health professional requesting the endoscopy, the patient's digestive history, the indications and the results or the procedure as well as the results of the biopsy wherever it was available. All patients were informed on the procedure and its purpose and were encouraged by the nurse assisting the physician. They were advised to be on empty stomach for at least eight hours and were administered oral lidocaine gel immediately before the procedure.

The endoscopy exam was implemented using an Olympus Evis Exera GIFQ 180 device connected to an Olympus Evis Exera 180 processor and a Sony monitor.

The endoscopist explored back and forth in axial vision the upper digestive tracts. The examination was done firstly with a white light and secondly with NBI function by a senior endoscopist. The whole procedure was registered and sent to two others senior endoscopists different from the one who implemented the endoscopy.

Savary and Muller's classification was used to categorize the Gastro Esophageal Reflux Diseases (GERD).

**Data analysis**

The categorical data were compared using the chi-square test with an alpha level of 5%. Chen’s Kappa coefficient has been used to assess the agreement between the two interpretations of the endoscopy records. The level of agreement was deemed very good for a Kappa’s coefficient higher than 0.81, good for a coefficient between 0.80 and 0.61, average between 0.60 and 0.41, poor between 0.40 and 0.21 and worst for less than 0.20. We used epi-info 3-5-3 statistical software to enter the data and SPSS software for the analysis.

**Results**

**Socio-demographic characteristics**

Seventy patients were included. The mean age was 37.5 for a range from 16 to 76 years. The age groups between 15 and 21 and 25 and 34 represented 55.7% of the whole sample. The sex ratio was 1.5 in favor of men. Among patients 28.5% were housekeepers, 20% were running a small business, 15% were civil servants or private sector workers and 7% were farmers. 57% of the endoscopies were requested by general practitioners and 20% by gastroenterologists. Epigastralgia was the main indication (83%) followed by pyrosis and abdominal pains for 27.1% and 21.4% of the cases respectively. 25.7% of our patients were alcohol consumers and 10% were current smokers; 17.1% received traditional medication.

**Endoscopic findings**

The total of lesions identified during the screening with white light were 23 (32.85%), among which 9 (12,85%) hiatal hernia and 5 (7.14%) Reflux esophagitis associated to hiatal hernia. Two patients had esophageal mycosis. We diagnosed one case of Barrett’s oesophagus. Using NBI function we found a total of 28 (40%) lesions, among which 9 (12.85%) cases of hiatal hernia, 11 (15,71%) cases of reflux esophagitis, 3 cases of lesions of Barrett’s oesophagus and one case of sessile polyp. Hiatal hernia was the most frequent disease with about half of the cases followed by the reflux esophagitis. Both diseases were associated in 21% of the cases (Table 1).

Diagnosis	White Light		NBI	
	Number (23)	Percentage	Number (28)	Percentage
Hiatal Hernia (HH)	9	39,13	9	32,14
Oesophagitis +HH	5	21,73	5	17,85
Reflux oesophagitis	4	17,39	6	21,42
Oesophagal mycosis	2	8,69	2	7,14
DBO	1	4,34	3	10,71
Varicous oesophagus	1	4,34	1	3,57
Mallory	1	4,34	1	3,57
Sessile polyp	0	0	1	3,57
Total	23	100	28	100

**Table 1:** Repartition of oesophageal diseases diagnosed by endoscopy.  
 HH: Hiatal Hernia; DBO: Barrett Oesophagus.

**Distribution of normal findings according to the method of examination**

Standard endoscopy with white light found 67.1% of normal results against 60.5% with the use of NBI function. The detection rates of abnormal results ranged from 32.9% to 39.5% for white light and NBI, respectively, meaning a differential rate of 6.6% (Figure 1). Though the difference was not significant, the Cohen’s kappa coefficient was 0.52% for white light endoscopy and 0.67 for NBI function (p < 0.99).

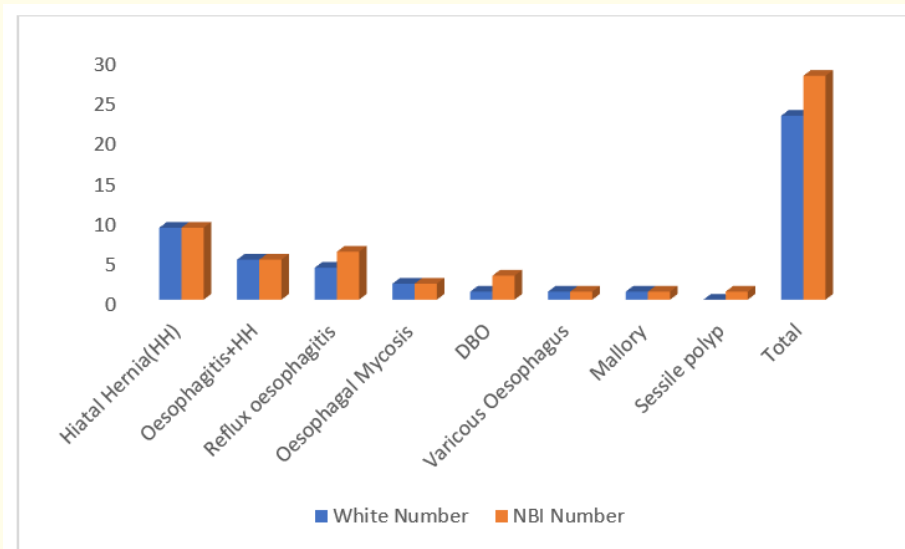


Figure 1: Proportion of lesions observed in white light and NBI.

**Distribution of the lesions according to the method of examination (white light versus NBI)**

The number of cases of hiatal hernia or esophageal mycosis detected with white light was similar to those diagnosed with NBI function. On the other hand, the number of reflux esophagitis cases and cases of Barrett’s oesophagus diagnosed by NBI function was higher than the number of cases detected using white light (Figure 1).

**Agreement between white light and NBI function according to the lesions detected**

The agreement between white light and NBI was 100% in all diagnosis of hiatal hernia and varicose esophagus; 77.8% of reflux esophagitis and 33.3% of doubtful Barrett’s oesophagus. The agreement between the endoscopists was 91.2% for reflux esophagitis, 84.5% for hiatal hernia and 61.5% for doubtful Barrett’s oesophagus (Figure 2).

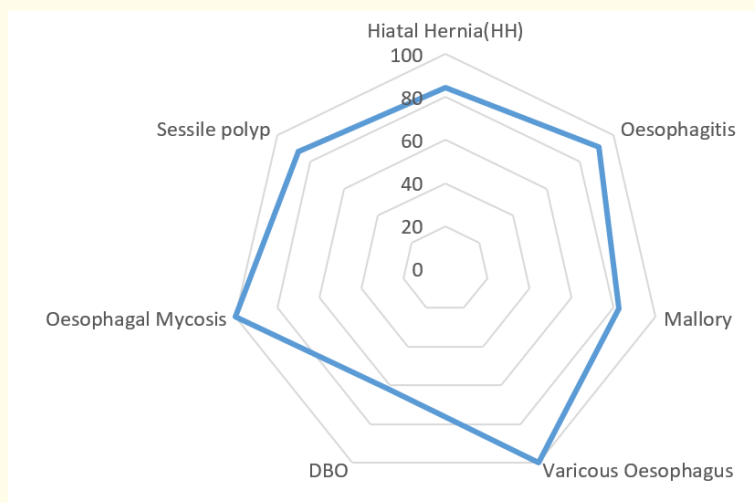
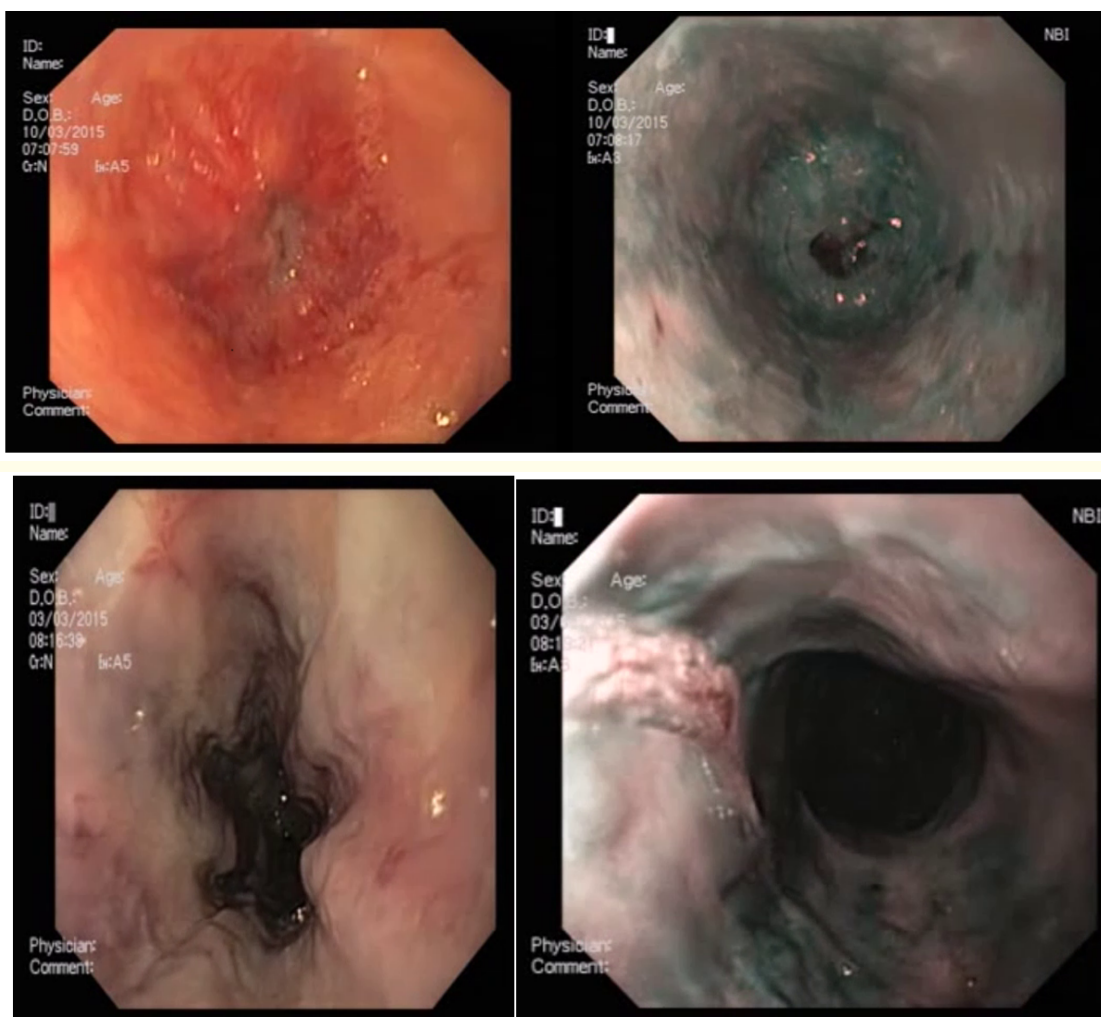


Figure 2: Concordance between endoscopists according to observed lesions.

### Discussion

The rate of abnormal result was 32.9% with the white light versus 39.5% for NBI implying a 6.6% increase in the detection rate. Study in Taiwan [5] found 65.5% of normal results with white light compared to 59.10% with NBI function, meaning an increase of 6.25% in the rate of lesions detection. Many studies achieved similar conclusions especially with respect to esophageal diseases complicated with the vascularization of the mucous membrane. Several studies found also an increase in the esophagus' vascularization and the micro lesions implementing the NBI function in symptomatic patients with GERD, at the opposite of the endoscopy with white light which found normal results (Figure 3).



**Figure 3:** Pictures of esophageal lesions in white light (WL) and NBI. Upper left: Reflux esophagitis WL; Upper right: Reflux œsophagitis NBI; Down left: esophageal varices WL; Down right: esophageal varices NBI. Source: Gastroenterology Unit of General Aboubacar Sangoule Lamizana Military Hospital.

In India study [6] found an improvement of the vascularization in 56.3% of cases while FOCK [7] identified the increase of vascularization and small erosions in 9.6% and 52.8% of the cases, respectively. Sharma, *et al.* [8] achieved the same conclusions. At the opposite Lundell, *et al.* [9] and Bytzer, *et al.* [10] found less performance of NBI with regard to the diagnosis of gastric esophageal reflux. The NBI had better results only with regard to grade 2 gastric esophageal reflux as per Savary and Muller's classification.

In our study the number of cases of hiatal hernia and esophageal mycosis detected by white light was similar to the number of cases diagnosed with NBI function. Besides, the number of reflux esophagitis and Barrett's oesophagus diagnosed with NBI function were higher than the number of cases detected only with white light. The percentage of reflux esophagitis detected by NBI was 15.21% compared to 12.32% for white light meaning an increase in the detection rate of 2.89% (Figure 1). This finding is similar to FOCK's [7] who reported an increase in NBI-detected reflux esophagitis. The NBI-associated increase recorded by Chung [11] was 43.6% of reflux esophagitis against 25.5% for white light ( $P = 0,005$ ). LEC found a rate of 29.01% of reflux esophagitis grade A with white light and 36.40 with NBI function for the same patients.

The sensitivity of conventional endoscopy to diagnose the reflux esophagitis is low (50%) [12]. The electronic coloration with NBI enables the identification of more subtle lesions of the oeso-gastric junction such as the alteration of the intra-papillary capillary loops and the junctional vascularization, the micro-erosions and the villous aspect of the junctional mucosa [7,9]. In USA, Sharma, *et al.* [8] found that these lesions were more frequent in gastric esophageal reflux. The micro-erosions were better visualized with a sensitivity of 93% [7,12]. A team in Singapur confirms the same findings for a group of 100 patients [13]. Regarding the Barrett's esophagus, the rate of detection of suspect areas improved from 1.42% with white light to 4.28% with the NBI function. Curver [13] had the same conclusion that the NBI function increased the rate of detection of the Barrett's oesophagus.

The NBI function by the selection of the spectrum is a technique of virtual coloration of digestive mucous membrane which objective is to realize endoscopic examination using different band of light to create a contrast between lesions and normal mucous membrane and to obtain new information [1,4]. The source of the light of the endoscopy machine gives a blue light (absorption of hemoglobin) who will enhance vascular structures. At some distance, lesions with its abnormal vascularization will appears brown, the normal mucous membrane is green and beige [3]. This difference of color facilitates the detection of abnormal areas appropriate to the endoscopy with while light. Its enables to mark out in case of Barrett's oesophagus. The glandular mucous membrane inside esophagus and describe Barrett's oesophagus easily [14,15]. Its favors to mark out, inside the mucous membrane intestinal metaplasia places of high grade of dysplasia or inside mucous membrane carcinoma. In case of macroscopic anomaly, it enables to determinate the nature and the extension of the lesion [16,17]. Many prospective multicentric studies had proved the benefit of NBI with the sensibility ranging from 55% in white light to 97% with NBI [18]. In association with the magnification, the sensibility to detect epidermoid lesions of less than 10 mm ranges from 39 to 94% [19]. Besides, NBI seems to give promising results in the surveillance of Barrett's oesophagus with the feature to target and to biopsy intestinal dysplasia area. A multicentric randomized study done by Sharma in 2013 proved that NBI with biopsy enables to detect high grade dysplasia reducing the number of biopsies. This constitutes a hope about the current difficult protocol of Seattle that recommends biopsy during surveillance of doubtful Barrett's oesophagus (DBO) [20].

The agreement between white light and NBI methods was about 77.8% in reflux esophagitis and 33.3% in suspected DBO. It was 100% in case of varicose esophagus. Though the NBI seems superior to the conventional endoscopy with white light in the diagnosis of some esophageal diseases like reflux esophagitis and suspected cases of DBO [5,12,13,15]. Both methods appear to be equivalent for other esophageal diseases like hiatal hernia and varicose esophagus. Therefore, NBI is usually used for the surveillance of DBO [15]. Many studies have investigated the dysplasia area with the NBI method because it enables to characterize the pit pattern [20]. Sharma, *et al.* also acknowledged the superiority of the NBI to better follow up the DBO. They didn't make any difference between NBI and white light for other diseases especially when it was on high resolution. Besides, Vesper [21] found that NBI was superior to standard endoscopy with

white light with respect to the diagnosis of ectopic gastric mucosa situated at the upper part of esophagus. He found that the increase in the detection rate was about 41.4%. Though, it has to be acknowledged that the endoscopist was well aware of what he had to look for.

Chunc [11] found the same results with a detection rate of 85.3% for NBI and 41.4% for standard endoscopy with white light especially if the diameter of ectopic mucosa was less than 5 mm.

Considering overall normal and abnormal results in the detection of the reflux esophagitis as per Los Angeles's classification, Cohen's kappa coefficient was 0.52 for conventional endoscopy with white light and 0.67 with NBI. Lee [5] achieved the same results.

Nagami [22] assessed the agreement between observers regarding the detection of esophagus's cancer with NBI. He achieved an excellent kappa correlation at 0.73 and an agreement of 0.84 between observers. However, Goichi [23] in a multicentric agreement study involving 28 endoscopists from 11 countries of pacific Asia, found a coefficient kappa of 0.31 with white light and 0.49 with NBI for the detection of dysplasia during the follow-up of DBO. Overall, both methods achieved a kappa value of 0.56.

Rastoghi was interested especially in the reproducibility of data obtained by electronic coloration [24]. In his study 4 investigators assessed the nature of many polyps using NBI. The kappa agreement score between observers was 0.63 for the prediction of the type of the polyp. The between-observers agreement varied between 0.61 and 0.81. Regarding the characterization of polyps, many other studies found a very good kappa's score. Especially Tischendorf, used only 2 observers without giving any detail on the method implemented for the reproducibility analysis [25]. East, *et al.* [26] provided precise information regarding their method but achieved a more modest kappa's score for the classification and analysis of vascular system (0.48 and 0.64, respectively). Regarding the reproducibility, Curvers' study on DBO determine a between-observers kappa's scores of 0.51 and 0.53 [27]. These findings were achieved by a multidisciplinary team of endoscopists and experts.

### Conclusion

During our study, we found an overall increase in the detection rate of esophageal diseases by NBI. We found a rate of 39,5% detection of abnormal results using NBI function as compared to 32,9% with the conventional endoscopy using white light. This finding was especially significant for the diagnosis of DBO and reflux esophagitis. Besides, the between-observers' agreement seemed to improve with the use of NBI. Though, digestive endoscopy results rely heavily on the operator. Therefore, considering our small sample size, it is clear that bigger studies may be required to achieve more accurate results.

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