

## Surgical Technique

# The Use of NBI in Early Detection and Follow up of the Laryngeal Malignancies

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### REZUMAT

#### *Utilizarea NBI în detecția precoce și monitorizarea pe termen lung a tumorilor maligne laringiene*

Detecția precoce și monitorizarea pe termen lung a tumorilor maligne laringiene este de obicei realizată utilizând examinarea cu fibră optică. Tumorile sub 1 mm sunt dificil de identificat la examinarea cu lumină albă, normală. Narrow Band Imaging (NBI) este o nouă tehnologie care utilizează un filtru optic conceput pentru a obține o lumină cu lungime de undă de 415 nm și 540 nm. Examinarea utilizând NBI permite chirurgului să vizualizeze rețeaua vasculară de la nivelul formațiunii tumorale. Capilarele de la nivelul mucoasei sunt evidențiate în culoarea maro, iar venele din submucoasă sunt colorate în turcoaz. Vizualizarea anomaliilor vasculare vor ghida chirurgul în realizarea unor biopsii țintite care vor fi utilizate în diagnosticul precoce și monitorizarea pacienților cu tumori laringiene maligne.

**Cuvinte cheie:** narrow band imaging (NBI), diagnosticare precoce, malignități laringiene

### ABSTRACT

Early detection and follow up of the laryngeal malignancies is usually done using the fiber optic exam. The tumors below 1 mm are difficult to be identified using normal white light. Narrow Band Imaging (NBI) is a new technology that uses an optical filter in order to obtain a light with fixed wave length of 415 nm and 540 nm. The special NBI allows the surgeon to visualize the vascular network at the site of the tumor. The mucosal capillaries are displayed in brown and the veins from the submucosa are displayed in cyan. Observing the abnormal vessel patterns will guide the surgeon in performing targeted biopsies that will be used in early detection and follow up of patients with laryngeal malignancies.

**Key words:** narrow band imaging (NBI), early detection, laryngeal malignancies

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## BACKGROUND

Laryngeal tumors are often discovered in advanced stages because the patients do not pay attention to early symptoms. Sometimes small tumors are difficult to see even if the surgeon performs a fiber optic exam that uses conventional white light. In the last years some technologies started to be used in order to help the surgeon to perform an early detection or to follow up de patient with laryngeal malignancies (1).

Early detection of laryngeal neoplasm is one of the most important factors for the success of the treatment. Visualizing abnormal modification at the follow up exam for patient with laryngeal cancer will help the surgeon to initiate the treatment for the recurrence. Some of technologies such as autofluorescence or video contact endoscopy started to be used for early detection of laryngeal malignancies (2,3).

In the past 2 years the examination using Narrow Band Imaging (NBI) was introduced in ENT practice. The method proved its efficacy in gastroenterology where it has been widely used for many years.

The principle of Narrow Band Imaging (NBI) is that the normal light is filtered using an optical filter in order to obtain a light with fixed wave lengths of 415 nm and 540 nm. The special NBI light allows the surgeon to visualize the vascular network at the site of the tumor. The mucosal capillaries are displayed in brown and the veins from submucosa are displayed in cyan. The NBI is an optical technology that enhances the vascular network from the epithelial layer.

## MATERIALS AND METHODS

We have started to perform video endoscopic exam using Narrow Band Imaging (NBI) light in order to early detect laryngeal malignancies and to follow up the patients known with laryngeal cancer (fig. 1, 2). After using it for a few moths we have established a protocol in order to obtain standard exam.

The endoscopic exam is performed, using local anesthesia, with a flexible endoscope that is inserted through the nose or with a rigid Hopkins endoscope, through the mouth. We are using a HDTV camera in order to obtain good quality images. For the flexible endoscopic exam a 3.6 mm diameter nasopharyngo-

scope is used and for the rigid endoscopic exam a 70 degree optic with a diameter of 10 mm.

For both type of examination we have started the exam using normal light emitted by the Xenon bulb of the light source. When we approach the laryngeal area, we switch on the NBI filter in order to enhance and to better observe the vascular network. The fiberscope is approached to the abnormal area and than we use the freeze function.

After freezing the desired area we can use the zoom function of the video processor to better view the details on the captured image.

The NBI filter will narrow the light frequency range to two length wave: one of 400-439 nm (centered at 415nm) and a second one to 525-555 nm (centered at 540 nm).

The red light, 415 nm wavelength light has less penetration and less scattering thus enhancing image resolution. The blue filter is designed to correspond to the peak absorption spectrum of hemoglobin to enhance the image of capillary vessels. The 540 nm wavelength light penetrates deeper and highlights the submucosal vascular plexus.

Improved contrast between the epithelium and the vascular network will provide the surgeon the opportunity to visualize lesions of a few millimeters in diameter.

Suspect findings during NBI flexible endoscopic exam are well demarcated brownish area with scattered brown dots. The brown dots are caused by intraepithelial papillary capillary loops expansion, which appear due to the neo angiogenesis process in the malignant tumor.

The surgeon can also distinguish the neo angiogenesis process from the post-irradiation edema that is characterized also by brown dots that are displayed without boundary line on the mucosa (4). If a suspect area is identified then a biopsy is recommended. Intraoperative use of NBI provides the surgeon with the abilities to perform targeted biopsy and to better define the area of resection.

We have to understand that NBI method has some limits as well. First of all is the impossibility to visualize the surface of the mucosa due to the stagnant saliva or mucus. This can be encountered in patients with oncological treatment. The second situation when we are not able to observe the mucosa clearly is hyperkeratosis lesions which prevent the direct view of the vascular network (fig. 3, 4).



**Figure 1.** Flexible endoscopic exam using normal white light - follow up after epiglottic neoplasm



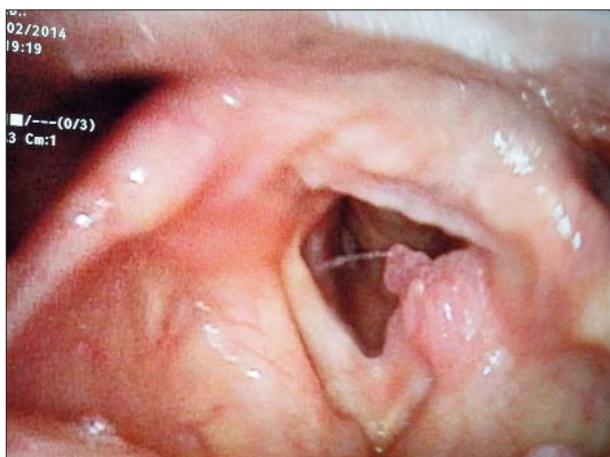
**Figure 2.** Flexible endoscopic exam using NBI - follow up after epiglottic neoplasm



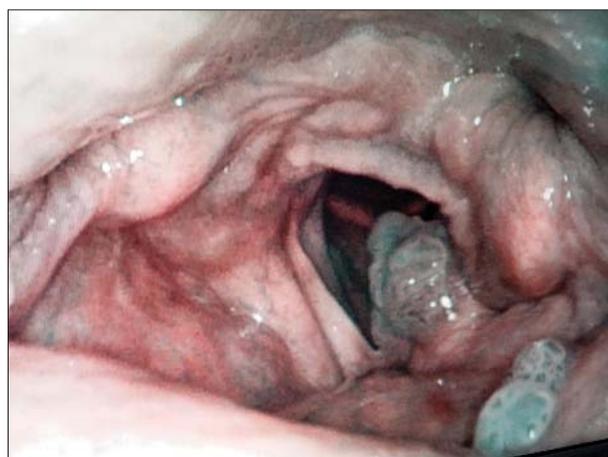
**Figure 3.** Flexible endoscopic exam using normal white light - chronic laryngitis with hiperkeratosis



**Figure 4.** Flexible endoscopic exam using NBI - chronic laryngitis with hiperkeratosis



**Figure 5.** Flexible endoscopic exam using normal white light - laryngeal papillomatosis



**Figure 6.** Flexible endoscopic exam using NBI - laryngeal papillomatosis

False positive results are reported in laryngeal papillomatosis (Fig 5, 6). In this case, using the zoom option of the HDTV processor will help to differentiate a papilloma from a malignant lesion.

Papilloma has a vessel microarchitecture that is regular, with a central vascular axis in each papilla. The neoplastic lesion has a irregular vascular design sometimes with disruption of the vascular network.

## RESULTS. DISCUSSION

We tried to determine and to calculate the sensitivity and the specificity of the NBI flexible endoscopic exam comparing with the biopsy result. The sensitivity and specificity of flexible NBI endoscopy in patients with laryngeal malignancies was 95% respectively 92%.

Histopathological examination cannot be replaced by endoscopic examination using NBI light.

## CONCLUSIONS

The use of Narrow Band Imaging exam for the early detection and follow up of the patients with laryngeal malignancies provides the surgeon the ability to detect smaller lesions comparing with the standard white light exam.

Using HDTV video processor will greatly improve the performance of the method and allows the surgeon to better define the lesion.

NBI technique provides the surgeon the oppor-

tunity to perform an intraoperative targeted biopsy.

The NBI limits are stagnant mucus and hyperkeratosis, situations when the mucosa can not be clearly displayed.

False positive results can be obtained, mistaken a papilloma with a cancerous lesion. Using HDTV processor can differentiate those pathologic entities.

The NBI exam can be performed easily with local anesthesia using flexible or rigid endoscopic exam and does not need special preparation of the patient.

Combining the NBI light with optical technologies as video contact endoscopy may enhance the sensitivity and specificity when used during surgery.

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