The Laryngoscope

How I Do It

High-Sensitivity FEES With NBI-Illumination

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INTRODUCTION

Flexible endoscopic examination of swallowing (FEES) with colored bolus is a routine procedure to assess swallowing function and check for laryngeal penetration and aspiration of colored liquids and solid food. With this method, sometimes it is not easy to decide whether colored bolus can be seen when only small amounts are diffusely spread on the mucosa of the pharynx and larynx or when the colored bolus gets diluted and therefore cannot be seen with enough contrast. Especially coloring of the trachea, which indicates aspiration, might be overlooked because the bolus is too far away to be easily visualized and also because of image resolution and illumination.

Narrow band imaging (NBI) is an image enhancement technology that normally is used to improve the visibility of superficial small vessels due to its strong absorption by hemoglobin. As a side effect of NBI illumination, the green color will turn red. This effect can be used in FEES.

We describe a technique for enhancing bolus contrast and visualizing even the smallest amounts of penetrated or aspirated bolus. By coloring the bolus with green food colorant and using NBI, the bolus will change its color from green to red; moreover, an enormous contrast enhancement is elicited. Even very thin secretion layers containing food colorant are easily detectable. Thus, with this technique even minor laryngeal penetration and aspiration can be detected, and early treatment can help prevent aspiration pneumonia.

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MATERIALS AND METHOD

Our routine procedure for FEES is bolus coloration using food colorant (light green, E 104 Chinolingelb + E 123 Indigotin I, Schreiber-Essenzen GmbH & Co. KG, Barsbüttel, Germany). We usually use one part of food colorant for two to three parts of water for liquids. With the new technique, we are able to dilute the bolus color by factor 10. For solid bolus, we add one scoop (15 mL) of instant food thickener to 50 to 100 mL green liquid for thickening of the bolus. While the flexible endoscope is placed transnasally (Flexible Video Endoscope ENT-VH, Olympus Medical Systems Corp., Tokyo, Japan), we ask the patient to swallow 1 teaspoon of liquid and solid bolus, respectively. During FEES, we use white light from pre- to postdeglutitive endoscopy. During the postdeglutitive respiratory phase, the illumination is switched to NBI mode. All videos are recorded on a Mac (iMac, Apple Inc., Cupertino, CA) for offline image analysis.

RESULTS

During NBI illumination, the green-colored bolus turns bright red, with an enormous contrast enhancement. Even the smallest amount of penetrated or aspirated bolus parts, as well as the thinnest diffuse secretion layers, can be visualized very well (Fig. 1a,b; Fig. 2a,b).

In some subjects without any other symptoms or hints of a swallowing disorder, we found minimal and discrete laryngeal penetration at the superior part of the laryngeal inlet, that is, the upper laryngeal rim of the epiglottis; the superior endolaryngeal aspect of the aryepiglottic folds; and the superior endolaryngeal interarytenoid region (Fig. 3a,b).

In some cases, the lens of the endoscope tip gets smeared by the green bolus; with NBI illumination, the whole image turns red. In these cases, the lens has to be cleaned, for example, by wiping it against the base of the tongue or by swallowing again.

DISCUSSION

Clearly visible penetration and aspiration need no other detection techniques than flexible endoscopy with white light illumination. The better the image resolution of the optical system, for example, with high-definition tip chip endoscopes, the better we can detect smaller parts and particles within the larynx. Furthermore, with good

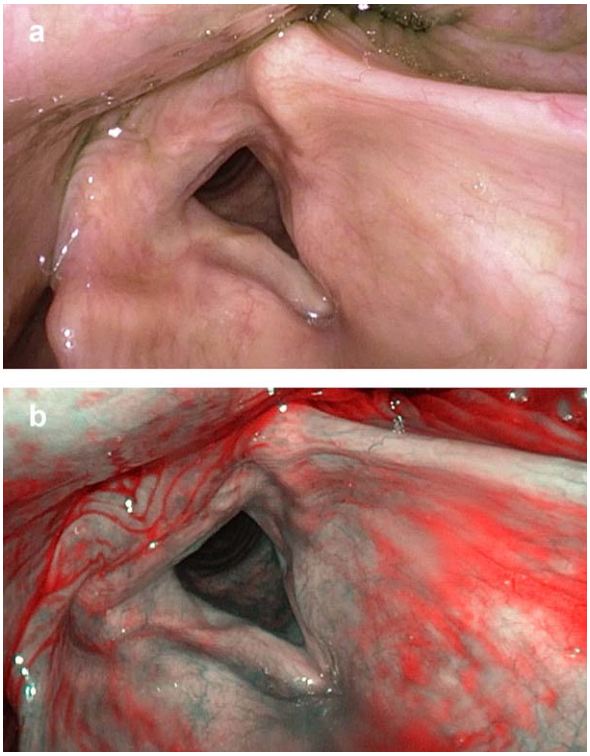

Fig. 1. Laryngeal penetration. (a) White light illumination versus (b) narrow-band imaging illumination. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

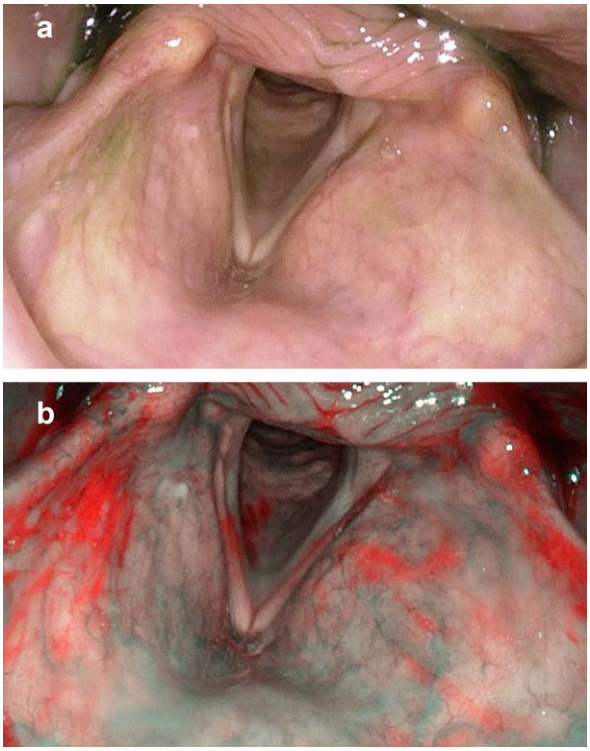

Fig. 2. Laryngeal penetration and aspiration. (a) White light illumination versus (b) narrow-band imaging illumination. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

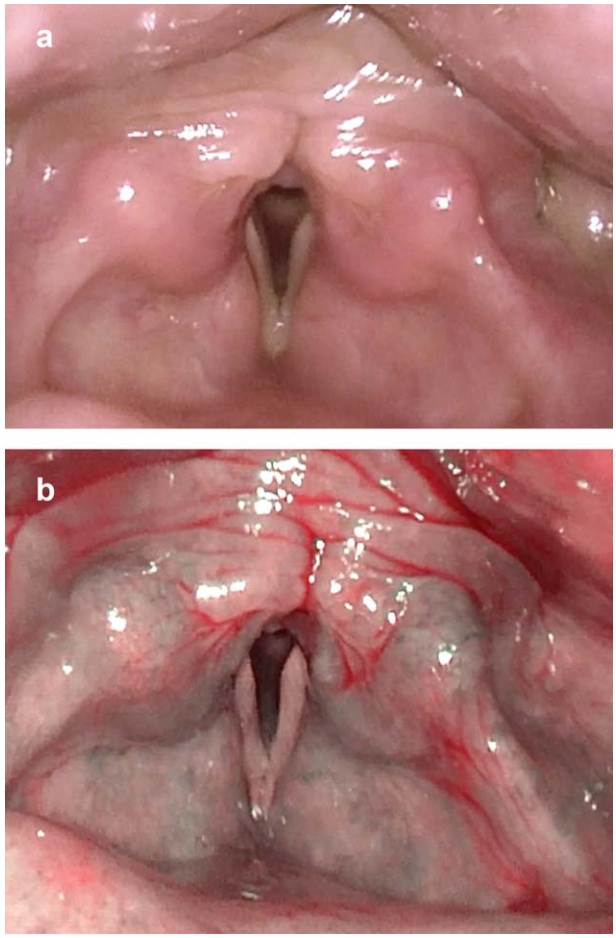

Fig. 3. Normal subject. (a) White light illumination versus (b) narrow-band imaging illumination. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

manual techniques such as the zoom endoscopy with a dipping maneuver, for which the tip of the endoscope dips into the endolarynx for a brief period of time during inhalation, the detection of penetrated and aspirated bolus can be facilitated. New and very useful is the property of green food colorant to change to the brightest red when using the NBI light mode. As a matter of fact, we have to explain to our patients that red does not mean bleeding before we discuss endoscopic findings during postexamination video reviewing. With this technical feature, even the tiniest amount of laryngeal penetration and aspiration can be visualized. Early detection allows for early treatment; as a consequence, aspiration pneumonia might be avoided.

Because we also saw discrete laryngeal penetration in many subjects without other hints of a swallowing disorder, that is, in a control group that would otherwise be assessed as normal, we assume that a new definition of normal laryngeal penetration versus pathologic laryngeal penetration in FEES might be necessary. In other words, although a categorical yes or no does not separate these groups, we might have to consider a quantitative measure as a possible threshold.

Unfortunately, it was not possible for us to try this color-change feature with comparable techniques of

other endoscope suppliers, for example, i-SCAN (Pentax Medical, Tokyo, Japan), SPIES (Karl Storz, Tuttlingen, Germany), or PIET (XION, Berlin, Germany), but we expect that they might work in a similar way, perhaps with bolus colorants other than green.

CONCLUSION

When using NBI and green food colorant during FEES, the combination of both can improve clinical diagnosis in cases of questionable penetration and aspiration. Due to the striking contrast of NBI illumination when using green food color, this method is very helpful to detect smallest amounts of diffusely spread bolus, as in laryngeal penetration and aspiration. In our clinical practice, this high-sensitivity FEES is now a routine procedure. Thus, by early detection and early treatment, aspiration pneumonia might be avoided.