



Narrow Band Imaging Endoscopy: Novel Diagnostic Method in the Hypertrophy of Inferior Turbinates

Stoelzel K*, Dommerich S, Bandelier M, Olze H and Szczeppek AJ

Department of Otorhinolaryngology, Head and Neck Surgery, Charité - Medical University, Germany

Abstract

Objectives: The narrow band imaging endoscopy (NBI) is an imaging method used by otolaryngologists for the examination of oral cavity, pharynx and larynx. Our present study was designed to determine the effectiveness of NBI in the examination of the inferior turbinate hypertrophy status.

Study Design: Individual cohort study.

Methods: A hundred and nine patients with enlarged inferior nasal conchae were enrolled. All subjects were examined prior to surgical intervention of conchae nasals inferior and were followed up to 6 months after the intervention. During the appointments, nasal endoscopy with white light, NBI endoscopy and the anterior rhinomanometry were performed. In addition, all subjects were asked about subjective nasal obstruction.

Results: Following surgery, the number of blood vessels in the nasal concha inferior was found to be reduced in all cases studied. The vascular imaging with NBI endoscopy produced significantly better results as the white light endoscopy. The decrease in the objective concha component correlated stronger with the NBI endoscopy than with white light endoscopy; however, the difference has not reached statistical significance.

Conclusion: NBI endoscopy allows fine tuning of the endoscopy scores and can therefore contribute to a standardized evaluation of the nasal inferior conchae by improving the diagnosis and monitoring of nasal mucosal vascular lesions.

Keywords: Narrow band imaging endoscopy; Concha nasalis inferior; Blood vessels; Nasal obstruction

Introduction

Nasal obstruction is one of the most common symptoms with which the ORL specialists are confronted in clinical practice. Common reason of nasal obstruction is the enlargement of inferior nasal concha (inferior turbinates). Conditions that contribute to the enlargement include allergic and non-allergic rhinitis, chronic hypertrophic rhinitis and a compensatory enlargement being a consequence of septal deviation [1,2]. Chronic inferior turbinate enlargement is not associated with cellular hypertrophy but rather with cellular hyperplasia, tissue oedema and vascular congestion [3]. One of the important hallmarks of turbinate enlargement is the increased number of blood vessels within the nasal mucosal tissues and dilatation of venous sinusoids within lamina propria. The number of laminar blood vessels correlates with positive therapy outcome, as it was reduced one month after electrocautery [4]. Enlarged sinusoids are beside fibrosis and inflammation the reason for an enlargement of inferior turbinates [5].

Clinical examination of nasal obstruction is performed with a use of anterior rhinoscopy and nasal endoscopy. Despite the attempts of Camacho et al. [6] to introduce the size of nasal concha as a marker of disease classification, no standard scoring system of the anterior rhinoscopy is so far in use. The endoscopic description of the inferior nasal concha, which was introduced by Meltzer et al. [7,8] as a so-called "endoscopy score", is based on the swelling status and on the color of affected tissue. Unfortunately, no further observations can be made with the use of white-light endoscopy.

The narrow band imaging (NBI) is an optical technology, which uses two specific wavelengths in order to improve the surface and the vascular representation of mucosa. NBI is based on the fact, that the penetration depth of light is wavelength-dependent and that specific spectral regions are particularly well absorbed by hemoglobin. The favored penetration wavelengths lay between

OPEN ACCESS

*Correspondence:

Katharina Stölzel, Department of Otorhinolaryngology, Head and Neck Surgery, Charité - Medical University, Campus Charité Mitte, Chariteplatz 1, 10117 Berlin, Germany, Tel: +4930450655072; Fax: +4930450555922; E-mail: katharina.stoelzel@charite.de

Received Date: 05 Aug 2016

Accepted Date: 10 Oct 2016

Published Date: 26 Oct 2016

Citation:

Stoelzel K, Dommerich S, Bandelier M, Olze H, Szczeppek AJ. Narrow Band Imaging Endoscopy: Novel Diagnostic Method in the Hypertrophy of Inferior Turbinates. *Clin Surg*. 2016; 1: 1163.

Copyright © 2016 Stoelzel K. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

440 and 460 nm (blue light), where the penetration of light is low and therefore the mucosal surface and feeding capillaries are clearly visible. The specific spectral region within 540-560 nm (green) is absorbed by hemoglobin, therefore the submucosal blood vessels can be imaged in an optimal way [9,10].

In the recent years, the NBI has been used for imaging of various internal organs [11,12]. In addition to the tumor evaluation and the determination of tumor-dependent neovascularization in the gastrointestinal tract, lungs, bladder, and many other organs, NBI has been also applied in ORL for the early detection of larynx, oropharynx- and hypopharynx- carcinomas [13-16]. Only few records about the use of NBI in the nasal cavity endoscopy have been published to date: one about the examination of hereditary hemorrhagic telangiectasia and another one about the examination of granulomatosis with polyangiitis [17,18]. However, to our best knowledge, no studies using NBI-examination of blood vessels in the enlarged inferior nasal concha or in the associated nasal obstruction were published so far.

Our study evaluated the application of NBI nasal endoscopy for the diagnosis and monitoring of enlarged inferior nasal concha. Moreover, we wanted to determine if the imaging results obtained with NBI nasal endoscopy correlate with the nasal breathing.

We studied patients with nasal obstruction who were scheduled for a surgery of enlarged inferior nasal concha. Three surgical techniques were included in the study: lateralized submucosal turbinectomy electrocautery and laser cautery.

Materials and Methods

Patients

This randomized, three-arm prospective study was approved by a local Ethics Committee (permit number EA1/188/13). One hundred and nine patients were initially enrolled in the study. The inclusion criteria were age between 18 and 70 years, both genders and a positive diagnosis of inferior nasal concha enlargement. The exclusion criteria included chronic rhinosinusitis, nasal surgery prior to this study, diabetes, nasal polyps, autoimmune diseases and coagulation disorders. All patients underwent surgical reduction of inferior nasal concha and the allocation to the surgical technique was randomized. For 75 subjects, full evaluation over six months (four appointments) could be done. Of these 75 patients, 19 were treated with lateralized submucosal turbinectomy, 26 with electrocautery and 30 with laser cautery.

Methods

During the first appointment prior to surgery, medical history was collected and the nasal endoscopy with flexible endoscope (Olympus ENF-P4 fiber scope) equipped with the EVIS EXERA III Video System Center CV-190 was performed with a viewing angle of 110°. The white light endoscopy was directly followed by the NBI endoscopy with the same distance to the concha (Figure 1A, B). For the statistical analyses, a specific grid was placed in the endoscopic image, which was of the same size in every shot. The blood vessels were counted in the grid of each picture of white light endoscopy (Figure 2) and then compared with the grid count from NBI endoscopy (Figure 3). In order to objectively determine the number of blood vessels, each a congruent cut out of 6.5 x 6.5 cm was selected. At a resolution of 96 x 96 DPI, the vessel Number of inferior turbinate per visual field was determined using a Neubauer chamber.

As an objective comparison parameter we used the results of

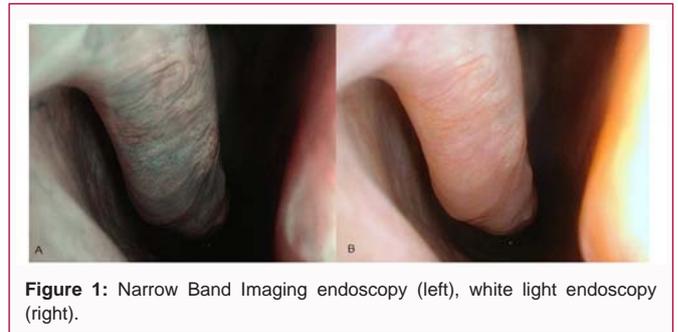


Figure 1: Narrow Band Imaging endoscopy (left), white light endoscopy (right).

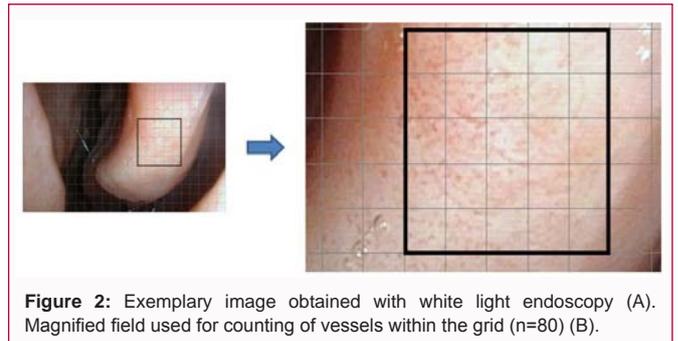


Figure 2: Exemplary image obtained with white light endoscopy (A). Magnified field used for counting of vessels within the grid (n=80) (B).

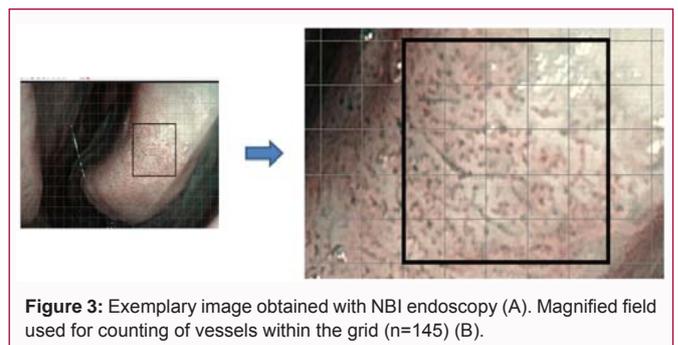


Figure 3: Exemplary image obtained with NBI endoscopy (A). Magnified field used for counting of vessels within the grid (n=145) (B).

anterior rhinomanometry (Rhino 4000, Homoth Medizinelektronik GmbH & Co KG, Hamburg, Germany). The total inspiration in milliliters per second was determined before and after decongestion of the nasal mucosa. The comparison of various parameters has been performed for each subject over time as well as between the various surgical procedures.

Following the rhinomanometry, the patients were asked to report their subjective nasal obstruction. Scoring ranging from 0 (no symptoms) to 4 (very severe symptoms) was applied, according to Likert scale. During follow up, the same question and scales were used during the appointments one month, three months and six months after surgical reduction of the inferior nasal concha.

Statistical analysis

The statistical analysis was performed with the IBM SPSS Statistics 22 for Windows. For the statistical test procedures a significance level of 0.05 was used ($\alpha = 5\%$). The treatment groups were also tested for differences in the time course. Because there is an incomplete repeated measures design (not all patients showed up for all 3 postoperative time points; not all questions were answered), the two-factor experimental design was checked for statistical significance using a between-subjects factor and a within-subjects factor according to the Generalized Estimating Equations (GEE) methodology [19,20].

Table 1: Comparison of the white-light endoscopy with the NBI endoscopy results.

	Vessels per field in NBI	Vessels per field in white light
Mean	76.89	28.94
Standard deviation	38.61	20.66
Median	70.00	24.00
Maximum	196.00	98.00
Minimum	10.00	0.00
n	71	71

T-Test: p = 0.000

Results

Comparison of the white-light endoscopy with the NBI endoscopy results

The visibility of blood vessels was significant better when using NBI, as compared to the white light endoscopy (p=0.00; t-test). Significantly more blood vessels could be identified by NBI (Table 1).

Changes observed using white light endoscopy during the consecutive appointments

During the first appointment (prior to surgery), the majority of blood vessels were localized on the surface of the inferior nasal concha. One to two months following surgery, only few blood vessels could be visualized using white light endoscopy, mainly due to the nasal secretion. Six months after the surgery, the visualization of the vessels improved and the number of visible blood vessels was lower than that on the first appointment (Figure 4).

Changes observed using NBI endoscopy during the consecutive appointments

During the first appointment, most blood vessels were identified on the surface of the mucosa and submucosa in the inferior nasal conchae. Despite the nasal secretion, the blood vessels could be clearly identified with NBI after surgery. Their number was

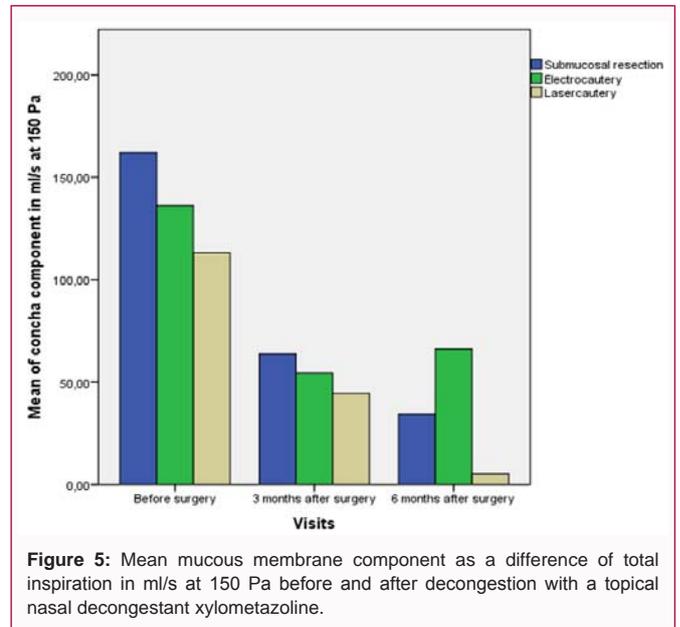
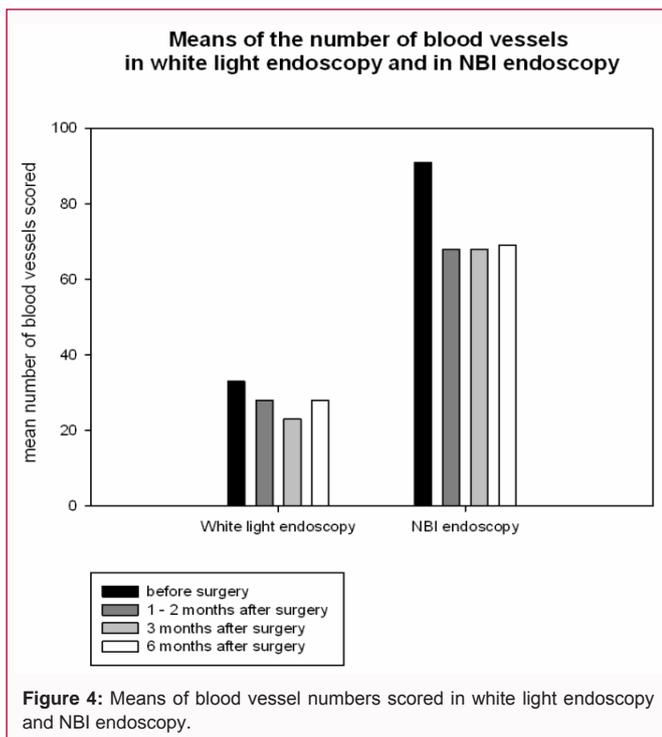


Figure 5: Mean mucous membrane component as a difference of total inspiration in ml/s at 150 Pa before and after decongestion with a topical nasal decongestant xylometazoline.

significantly lower than before surgery and nearly constant during all appointments (Figure 4).

Post-operative, temporal changes in the objective nasal obstruction – individual and between-group comparison

The objective changes in the nasal obstruction were measured using differences of mean values determined by the total inspiration (in ml/s at a pressure of 150 Pa) with anterior rhinomanometry before and after decongestion with a topical nasal decongestant xylometazoline. So we measured the concha component. Six months after surgery, the concha components have significantly decreased in all three groups as compared with the preoperative findings (Figure 5).

Post-operative, temporal changes in the subjective nasal obstruction

In all three groups studied (lateralized submucosal turbinectomy, electrocautery and laser acutery), the patients reported a significant improvement of symptoms in terms of nasal obstruction following surgery. However, two and three months following surgery there was a significant difference between the groups in favor of laser acutery (p=0.032). Six months after surgery, the differences between the groups were no longer significant.

Discussion

In the neoplastic tissues, typical composition of the mucosal and submucosal layers is altered in the nasal cavity and especially in inferior turbinates. Moreover, the presence of capillaries in the lamina propria and venous sinusoids of lamina submucosa significantly contribute to the tissue enlargement [3]. Berger et al. [5] has suggested that the increase in the number of capillaries may be responsible for the enlargement of venous sinusoids whereas Talaat et al. [4] hypothesized that the number of small vessels in the mucosal and submucosal tissues causatively associates with the tissue enlargement. Our evidence supports these hypotheses, because we have demonstrated significant difference in the number of blood vessels between the white light- and NBI endoscopies.

The narrow band imaging was first described in 2004 by Yoshida et al. [21] as a diagnostic measure of oesophageal lesions. Ever

since, narrow band imaging has been used in many studies as an indispensable part of gastrointestinal tract endoscopy [12] and the lung endoscopy [22]. Also in the otorhinolaryngology, the narrow band imaging found its application in the early diagnostic of the oral cavity- and oropharynx carcinomas [23,24]. In the present study, we have determined the usefulness of NBI for the examination of nasal mucosa in cases of nasal obstruction. To exclude the effect of septoplasty, we measured the mean value of conchae components and found that it significantly decreases after surgery in all intervention groups. Likewise, the number of blood vessels scored in the NBI endoscopy has decreased over the time in all intervention groups. NBI endoscopy uses filtered white light to imagine blood vessels in the mucosal and submucosal tissues [3-5]. However, to date, the non-invasive diagnostic methods used to determine pathologies in inferior nasal concha was mainly done using non-filtered, white-light endoscopy and so called "Meltzer score" or "endoscopy score" [8]. The use of NBI in determination of chronic enlargement of inferior turbinates has never been described before. In our study, the diagnostic use of standard white light endoscopy was extended by means of complementing measures, which can easily be added to conventional endoscopy. In addition to the color and the grade of mucosal tissue swelling obtained with the white-light endoscopy, the NBI endoscopy offers important information about the number of blood vessels in inferior nasal concha. This information can be used to estimate vascularization index in nasal tissues, which cannot be obtained with the white-light endoscopy. Importantly, the results of NBI endoscopy proved to be unaffected to the presence of nasal secretion, which was not the case for white light endoscopy. In the present study, we demonstrated that the visualization of blood vessels during first few months after surgical intervention is compromised if not impossible when using the conventional, white light endoscopy. At the same time, the blood vessels could be easily monitored with the NBI endoscopy.

Our study not only demonstrated feasibility of using NBI endoscopy for the diagnosis and monitoring of patients with inferior nasal concha enlargement, but also detected a trend in the outcome of various surgical techniques used for treatment of this common condition. This trend points at beneficial use of the laser cautery in terms of objective and subjective measurements. However, larger study sample representing all three groups are required to come to concise clinical conclusions.

Conclusion

In the present work, we demonstrate the usefulness of NBI endoscopy in the diagnosis and post-surgical monitoring of inferior nasal concha enlargement. The quick change between white light and NBI during the nasal endoscopy is useful and time-saving. Extended specification of endoscopy scores and the ability to determine typical morphology of nasal mucosa by NBI endoscopy could improve the diagnosis and treatment of nasal mucosa pathologies.

References

- Baumann I, Baumann H. A new classification of septal deviations. *Rhinology*. 2007; 45: 220-223.
- Larrabee YC, Kacker A. Which inferior turbinate reduction technique best decreases nasal obstruction? *Laryngoscope*. 2014; 124: 814-815.
- Farmer SEJ, Eccles R. Chronic inferior turbinate enlargement and the implications for surgical intervention. *Rhinology*. 2006; 44: 234-238.
- Talaat M, el-Sabawy E, Baky FA, Raheem AA. Submucous diathermy of the inferior turbinates in chronic hypertrophic rhinitis. *J Laryngol Otol*. 1987; 101: 452-460.
- Berger G, Gass S, Ophir D. The histopathology of the hypertrophic inferior turbinate. *Arch Otolaryngol Head Neck Surg*. 2006; 132: 588-594.
- Camacho M, Zaghi S, Certal V, Abdullatif J, Means C, Acevedo J, et al. Inferior turbinate classification system, grades 1 to 4: development and validation study. *Laryngoscope*. 2015; 125: 296-302.
- Hirunwiwatkul P, Udomchotphruet P. Efficacy study of nasal irrigation after radiofrequency tissue volume reduction for inferior turbinate hypertrophy: An equivalence randomized controlled trial. *American journal of rhinology & allergy*. 2012; 26: 497-503.
- Meltzer EO, Hamilos DL, Hadley JA, Lanza DC, Marple BF, Nicklas RA, et al. Rhinosinusitis: Developing guidance for clinical trials. *Otolaryngology-head and neck surgery*. 2006; 135: S31-S80.
- Gono K, Obi T, Yamaguchi M, Ohyama M, Machida H, Sano Y, et al. Appearance of enhanced tissue features in narrow-band endoscopic imaging. *J Biomed Opt*. 2004; 9: 568-577.
- Uedo N, Ishihara R, Iishi H, Yamamoto S, Yamamoto T, Yamada T, et al. A new method of diagnosing gastric intestinal metaplasia: narrow-band imaging with magnifying endoscopy. *Endoscopy*. 2006; 38: 819-824.
- Larghi A, Lecca PG, Costamagna G. High-resolution narrow band imaging endoscopy. *Gut*. 2008; 57: 976-986.
- Louie JS, Richards-Kortum R, Anandasabapathy S. Applications and Advancements in the Use of High-resolution Microendoscopy for Detection of Gastrointestinal Neoplasia. *Clin Gastroenterol Hepatol*. 2014; 12: 1789-1792.
- Goda K, Dobashi A, Tajiri H. Perspectives on narrow-band imaging endoscopy for superficial squamous neoplasms of the oropharynx and esophagus. *Dig Endosc*. 2014; 26: 1-11.
- Irjala H, Matar N, Remacle M, Georges L. Pharyngo-laryngeal examination with the narrow band imaging technology: early experience. *European archives of oto-rhino-laryngology*. 2011; 268: 801-806.
- Kraft M, Fostiropoulos K, Gurtler N, Arnoux A, Davaris N, Arens C. Value of narrow band imaging in the early diagnosis of laryngeal cancer. *Head Neck*. 2014; 38: 15-20.
- Piazza C, Dessouky O, Peretti G, Cocco D, De Benedetto L, Nicolai P. Narrow-band imaging: a new tool for evaluation of head and neck squamous cell carcinomas. Review of the literature. *Acta Otorhinolaryngol Ital*. 2008; 28: 49-54.
- Pagella F, Pusateri A, Chu F, Caputo M, Danesino C, Matti E. Narrow-band imaging in the endoscopic evaluation of hereditary hemorrhagic telangiectasia patients. *Laryngoscope*. 2013; 123: 2967-2968.
- Trimarchi M, Bozzolo E, Pilolli F, Bertazzoni G, Campochiaro C, Sabbadini MG, et al. Nasal mucosa narrow band imaging in granulomatosis with polyangiitis (Wegener granulomatosis): A preliminary study. *American journal of rhinology & allergy*. 2015; 29: 170-174.
- Dobson AJ. *An Introduction to Generalized Linear Models*. 2002.
- Hardin JW. *Generalized Estimating Equations*. 2001.
- Yoshida T, Inoue H, Usui S, Satodate H, Fukami N, Kudo SE. Narrow-band imaging system with magnifying endoscopy for superficial esophageal lesions. *Gastrointest Endosc*. 2004; 59: 288-295.
- Hanna WC, Yasufuku K. Bronchoscopic staging of lung cancer. *Ther Adv Respir Dis*. 2013; 7: 111-118.
- Vu AN, Farah CS. Efficacy of narrow band imaging for detection and surveillance of potentially malignant and malignant lesions in the oral cavity and oropharynx: a systematic review. *Oral Oncol*. 2014; 50: 413-420.
- Vergez S, Moriniere S, Dubrulle F, Salaun PY, De Monès E, Bertolus C, et al. Initial staging of squamous cell carcinoma of the oral cavity, larynx and pharynx (excluding nasopharynx). Part I: Locoregional extension assessment: 2012 SFORL guidelines. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2013; 130: 39-45.