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SHORT COMMUNICATION

The nose oropharynx hypopharynx and larynx (NOHL) classification: a new system of diagnostic standardized examination for OSAHS patients

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Abstract The main pathological event of obstructive sleep apnea hypopnea syndrome (OSAHS) is the apneic collapse of the upper airways (UA). Frequently, UA collapse occurs at the same time at different section levels. Identifying the site and the dynamic pattern of obstruction is mandatory in therapeutical decision-making, and in particular if a surgical therapy option is taken into account. Nowadays, awake fiberoptic nasopharyngeal endoscopy represents the first level diagnostic technique to be performed in such patients, but recently, the drug-induced sleep endoscopy (DISE) has been introduced to overcome the limits of the awake nasopharyngeal endoscopy. Whatever diagnostic tool we decide to use, one of the main problems encountered is the standardization of the description of the sites and dynamic patterns of UA collapses. In this paper, the authors describe the NOHL classification, which could be applied during awake and sleep endoscopy, and allows a simple, quick, and effective evaluation of grade and patterns of UA collapse, suggesting its application, especially in therapeutical decision-making and in the analysis of surgical outcomes.

Keywords Obstructive apnea hypopnea syndrome · Diagnostic classification

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Abbreviations

OSAHS	Obstructive sleep apnea hypopnea syndrome
UA	Upper airways
DISE	Drug-induced sleep endoscopy
ENT	Ear nose and throat
NOHL	Nose oropharynx hypopharynx and larynx

Introduction

The main pathological event of obstructive sleep apnea hypopnea syndrome (OSAHS) is the apneic collapse of the upper airways (UA). The most frequent sites of pharyngeal collapse are soft palate, lateral pharyngeal walls, palatine tonsils, and base of the tongue. The larynx can be involved as a site of obstruction, at epiglottis level in most cases. Frequently, UA collapse occurs at the same time at different section levels. Identifying the site and the dynamic pattern of obstruction is mandatory in therapeutical decision-making, and in particular if a surgical therapy option is taken into account.

Nowadays, there are several diagnostic tools which can be useful for the OSAHS patients' clinical examination, but awake fiberoptic nasopharyngeal endoscopy represents the first level diagnostic technique performed in such patients.

Recently, the drug-induced sleep endoscopy (DISE) has been introduced to overcome the limits of the awake nasopharyngeal endoscopy. It consists of an endoscopy carried out during different steps of sedation obtained by different sedative agents [1, 2].

Whatever diagnostic tool we decide to use, one of the main problems encountered is the standardization of the

description of the sites and dynamic patterns of UA collapses.

In this paper, the authors describe a new system of diagnostic classification of the sites of upper airways obstruction, which could be applied during awake and sleep endoscopy.

Our clinical diagnostic approach to OSAHS patients

All patients usually undergo otorhynolaryngoiatric evaluation that includes a complete traditional ENT examination in the sitting position. Then we perform a complete awake endoscopic examination of the UA, first through the mouth with the purpose of analyzing the grade of opening of the mouth, the anatomy of the soft palate, the presence and grade of palatine tonsillar hypertrophy, and the volume of the tongue. After that an endoscopic evaluation of the UA through the nose, with the patient in the supine position, during which a modified Muller maneuver (forced inspiratory suction with mouth and nose closed), at oropharyngeal and hypopharyngeal levels, is carried out.

In selected patients we decide to carry out a DISE, according to the most common protocol reported in the literature [1, 2]. During both endoscopic approaches we apply our diagnostic classification system.

Nose oropharynx hypopharynx larynx classification (NOHL) (Table 1)

Grade and patterns of upper airways collapse were evaluated at the nasal cavities (nose), retropalatal space (oropharynx), and base of the tongue space (hypopharynx). We defined, a total collapse of pharyngeal walls during Muller maneuver as grade 4, a collapse <75% as grade 3, a collapse <50% as grade 2, no collapse during Muller maneuver as grade 0. We used the same classification for the nasal cavities from 4 to 0, if we found the presence of obstructive nasal septum deviation, inferior turbinate hypertrophy, or other nasal obstructive pathology. Furthermore, the same grading system could be applied during a hypopnea/apnea event observed while performing the sleep endoscopy (see Table 1).

We also define the different patterns of pharyngeal collapse as: (1) transversal (t), if a lateral pharyngeal collapse with movement of the lateral pharyngeal walls towards the center of the airway is identified; (2) anterior–posterior (ap), if a collapse due to anterior pharyngeal collapse against the posterior pharyngeal wall is detected, and (3) concentric (c), if a combination of lateral plus anterior–posterior pharyngeal walls collapse pattern is visualized (Figs. 1, 2, 3).

We eventually record the presence of different laryngeal obstruction (larynx) (reported as p: positive or n: negative), specify at supraglottic (a) or glottis (b) level (Figs. 4, 5). In this way, it is possible to easily define the several sites and patterns of nasal obstruction and pharyngeal collapse, N.0–4; O.0–4 c,t,ap; H.0–4 c,t,ap; L. p,n like TNM system in oncologic field.

If we observed a significant grade of palatine tonsillar hypertrophy (grade 3 or 4), we reported it in the final

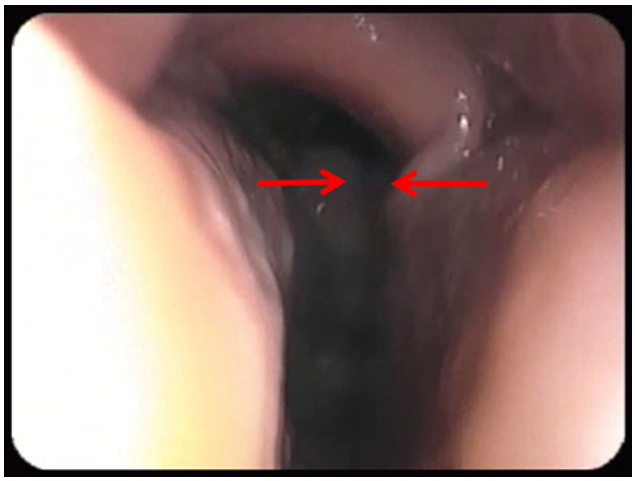

Fig. 1 Transversal pattern of pharyngeal collapse, in which a pharyngeal collapse with movement of the lateral pharyngeal walls towards the center of the airway is identified (during the Muller Maneuver in awake patient)

Table 1 NOHL classification. We add palatine tonsillar hypertrophy grade (3 or 4), if this is the case

Site	Nose static obstruction	Oropharynx	Hypopharynx	Larynx a: supraglottic b: glottic
Static nasal obstruction/pharynx collapse % grade value [1–4]	0–25%: 1 25–50%: 2 50–75%: 3 75%–100%: 4	0–25%: 1 25–50%: 2 50–75%: 3 75%–100%: 4	0–25%: 1 25–50%: 2 50–75%: 3 75%–100%: 4	Positive or negative collapse/obstruction

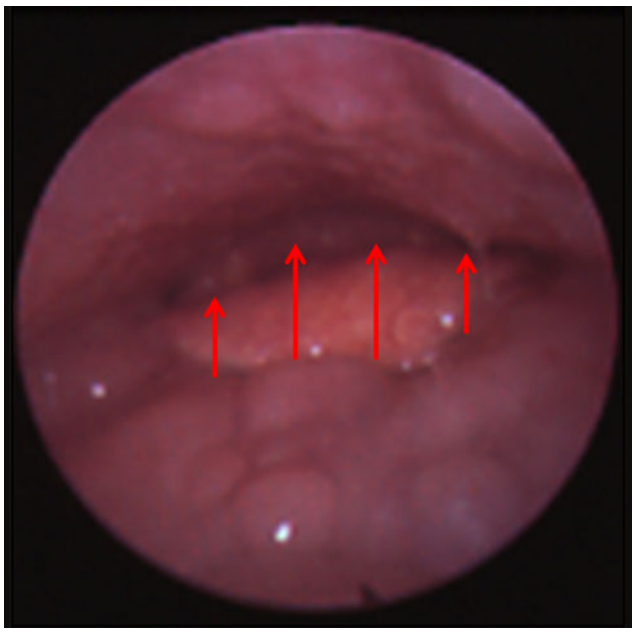

Fig. 2 Anterior–postetrior pattern of pharyngeal collapse in which a collapse due to anterior pharyngeal collapse against the posterior pharyngeal wall is detected (the base of the tongue against pharyngeal wall during the DISE)

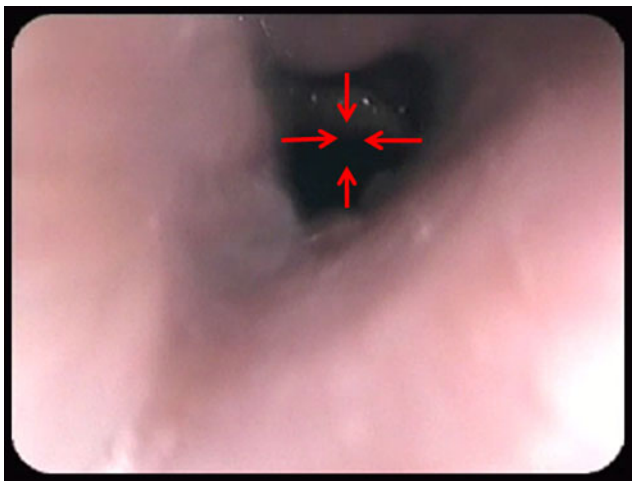

Fig. 3 Concentric pattern of pharyngeal collapse in which a combination of anterior–posterior and transversal patterns is visualized (at the retropalatal region during the DISE)

record as TS (3 or 4). If this was the case, we added it to the NOHL classification (for an instance: N3O4c*TS4*H2tLn).

Discussion

Many clinical diagnostic classifications for OSAHS patients are reported in the literature by several authors like Fujita, Sher, Friedman, and Kezirian (B) in [3–6]. A critical analysis of these systems is out of the aim of this paper.

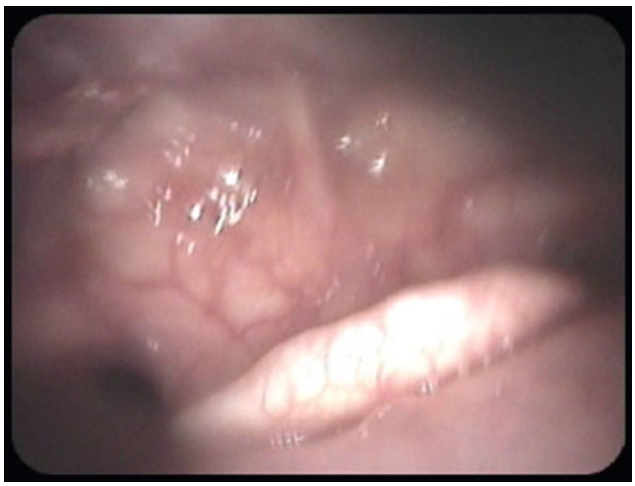

Fig. 4 Laryngeal collapse (primary epiglottic collapse during the DISE)

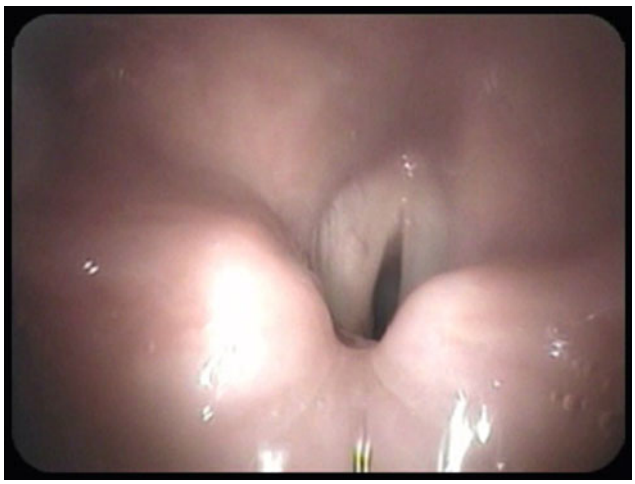

Fig. 5 Laryngeal obstruction (glottic obstruction during the DISE due to paradoxical vocal adduction during inspiration in a patient suffering from multiple systemic atrophy)

The NOHL classification system has been applied at our institution since 1996 and it has been developed in collaboration with the ENT clinic of University of Pavia. Nowadays the NOHL system is perform in several Italian ENT institutions.

We would like to underline several advantages of our system: (1) it describes all sites of the upper airways involved in the apneic obstruction, (2) it aims at showing all the dynamic patterns of pharyngo-laryngeal wall collapse, specifying the grading of collapse, (3) it could be applied both in awake fiberendoscopic examination and in DISE, (4) it allows a correlation with the other diagnostic tools, like panorex or teleradiography, (5) it allows rapid and clear exchange of clinical data among colleagues, and (6) it is a simple diagnostic classification with a quick training curve.

Conclusion

The NOHL classification system in OSAHS patients represents a simple, quick, and effective diagnostic tool and we suggest its application, especially in therapeutical decision-making and in the analysis of surgical outcomes.

Conflicts of interest None.

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