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ORIGINAL ARTICLE

Oropharyngeal Dysphagia in Patients with Obstructive Sleep Apnea Syndrome

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Abstract Although previous studies demonstrated that patients with obstructive sleep apnea syndrome (OSAS) may present subclinical manifestations of dysphagia, in not one were different textures and volumes systematically studied. The aim of this study was to analyze the signs and symptoms of oropharyngeal dysphagia using fiberoptic endoscopic evaluation of swallowing (FEES) with boluses of different textures and volumes in a large cohort of patients with OSAS. A total of 72 OSAS patients without symptoms of dysphagia were enrolled. The cohort was divided in two groups: 30 patients with moderate OSAS and 42 patients with severe OSAS. Each patient underwent a FEES examination using 5, 10 and 20 ml of liquids and semisolids, and solids. Spillage, penetration, aspiration, retention, and piecemeal deglutition were considered. The penetration–aspiration scale (PAS), pooling score (PS), and dysphagia outcome and severity scale (DOSS) were used for quantitative analysis. Each patient completed the SWAL-QOL questionnaire. Forty-six patients (64 %) presented spillage, 20 (28 %) piecemeal deglutition, 26 (36 %) penetration, and 30 (44 %) retention. No differences were found in the PAS, PS, and DOSS scores between patients with moderate and severe OSAS. Patients with severe OSAS scored higher General Burden and Food selection subscales of the SWAL-QOL. Depending on the DOSS score, the cohort of patients was divided into those with and those without signs of dysphagia. Patients with signs of dysphagia scored lower in the General Burden and Symptoms subscales of the SWAL-QOL. OSAS patients show signs of swallowing impairment in about half of the population; clinicians involved in the management of these patients should include questions on swallowing when taking the medical history.

Keywords Deglutition · Deglutition disorders · Obstructive sleep apnea syndrome · Fiberoptic endoscopic evaluation of swallowing

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Introduction

Obstructive sleep apnea syndrome (OSAS) is a sleep-related breathing disorder characterized by repeated episodes of upper airway occlusion that result in brief periods of breathing cessation (apnea) or a marked reduction in airflow (hypopnea) during sleep. These episodes are associated with oxyhemoglobin desaturation, persistent inspiratory efforts against the occluded airway, and arousal from sleep in order to reestablish airway patency [1]. OSAS appears to be associated with a range of cardiovascular and neurobehavioral impairments and represents a major public health problem [2, 3].

Recent studies have shown that patients with OSAS may be affected by swallowing abnormalities. In particular, Teramoto et al. [4] demonstrated that the water-stimulated swallowing reflex is delayed, and the duration of inspiratory suppression before the initiation of the next breath following a swallowing movement was significantly shorter in patients with OSAS when compared to control subjects. In videofluoroscopic studies, Jäghagen et al. [5, 6] observed deviant pharyngeal swallowing function, impaired bolus control with premature leakage, and delayed evocation of the swallowing reflex in patients with OSAS and in snorers compared to healthy controls. In addition, Teramoto et al. [7] reported that oxyhemoglobin desaturation and hypercapnia may be associated with the mechanisms of the impaired swallowing function in patients with OSAS. Finally, Valbuza et al. [8], using fiberoptic endoscopic evaluation of swallowing (FEES), found that patients with OSAS had premature oral leakage and pharyngeal stasis of the bolus even if no laryngeal penetration or tracheal aspiration was observed.

Although previous studies demonstrated that patients with OSAS presented subclinical manifestations of abnormal swallowing, this has not been systematically studied in anyone using boluses of different textures and volumes. In the Valbuza et al. study [8], in fact, only 11 patients were studied, and even though boluses of various textures were tested, the effect of different volumes was not investigated. In addition, no reliable quantitative scales were used to analyze the presence of penetration, aspiration, and retention. Moreover, in the Results section of their article, although the authors reported the percentage of patients with swallowing dysfunction, they did not specify with which texture those results were found. In the study by Jäghagen et al. [5], 41 patients underwent videofluoroscopy but only boluses of solid consistency were tested.

The aim of this study was to analyze the signs and symptoms of oropharyngeal dysphagia using FEES examination with boluses of different textures and volumes in a large cohort of patients with OSAS of different severity in order to evaluate the influence of OSAS severity on swallowing. The impact of different bolus volumes and textures on swallowing will lead to a deeper understanding of swallowing behavior in patients with OSAS. The importance of the study is that a better understanding of swallowing impairment in patients with OSAS may impact the clinical management of these patients. Currently, swallowing is not investigated in patients with OSAS; knowing which food textures and volumes are more commonly impaired in OSAS patients may support clinicians in history taking and subsequent clinical investigations.

Materials and Methods

This cross-sectional study was performed in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of the L. Sacco Hospital in Milan. All patients enrolled in the study gave their written informed consent; all data were collected prospectively.

Participants

Seventy-two patients (54 men and 18 women) with OSAS and without symptoms of dysphagia were enrolled consecutively in this study. The patients were referred by the pneumologist to the ENT Department of our hospital and underwent an otolaryngological examination to assess the anatomical characteristics of the upper airways. The mean age of the patients was 60.1 ± 11.1 years (range = 24–75). The inclusion criterion was mini mental state examination >24, preserved reading skills. The exclusion criteria were age >75 years (to reduce the risk of including patients with presbyphagia [9, 10]), diabetes, chronic obstructive pulmonary disease, gastroesophageal reflux disease, and neurological diseases.

Each patient underwent an unattended full-night polysomnographic (PSG) study using a standard technique. Briefly, PSG study was performed using a computer-assisted device (Pamela, Medatec, Brussels, Belgium). The electroencephalogram, electro-oculogram, and submental and tibial electromyogram were recorded with surface electrodes using standard techniques, as well as a one-lead ECG. A nasal cannula and thoracic and abdominal belts with attached piezoelectrodes recorded airflow and ventilator effort, respectively. Oxyhemoglobin saturation was recorded by finger pulse oximetry. The transducer and lead wires allowed normal position changes during sleep. Bedtime and waking time were at the subject's discretion and the study was terminated after final awakening. The sleep studies were scored by an expert sleep technician according to standard international criteria [11].

Depending on the severity of OSAS, the cohort of patients was divided in two groups. Group 1 included 30 patients with moderate OSAS ($15 < AHI < 30$) and Group 2 included 42 patients with severe OSAS ($AHI > 30$). The mean age of Group 1 was 61.4 ± 8.8 years (range = 37–75), and the mean age of Group 2 was 59.2 ± 12.6 years (range = 24–75).

Instrumental Assessment of Swallowing

All the patients underwent a fiberoptic evaluation of swallowing (FEES) exam. A flexible endoscope with a Storz FNL-10RP2 fiberscope (STORZ Endoskop Productions GmbH, Tuttlingen, Germany) was used. To analyze the signs and symptoms of oropharyngeal dysphagia, boluses of different textures (thin liquid, semisolid, and solid) and volumes were provided during the FEES examination. With respect to the liquid and semisolid textures, volumes of 5, 10, and 20 ml were used. Room-temperature blue-dyed water was used for the thin-liquid trials, and room-temperature, gelatinized water (Nestlè Nutrition) was used for the semisolid trials. For the solid texture bolus, a quarter and a half of an 8-g cookie were used. A minimum of three trials for each volume and texture were performed. Each examination was video recorded and directly stored on a CD-ROM for further analysis.

Spillage, piecemeal deglutition, penetration–aspiration, and pooling were considered. Spillage was defined as the bolus falling over the base of the tongue or lower this level before whiteout. Piecemeal deglutition was defined as division of the bolus into two or more swallows in succession rather than swallowing the entire bolus in one piece. Penetration was defined as the bolus entering the laryngeal vestibule, over the rim of the larynx. Aspiration was defined as the bolus passing below the true vocal folds. Pooling was defined as the bolus left in the oro- or hypopharynx. For quantitative measures after the FEES examination, the pooling score (PS) [12], the penetration–aspiration scale (PAS) [13, 14], and the dysphagia outcome and severity scale (DOSS) were used [15]. Two separate operators scored independently each video recording, and only in case of disagreement was a consensus reached through a joint analysis of the video recording in question. To ensure the stability and accuracy of the data, the clinicians involved in the FEES examination and the PS, PAS, and DOSS scoring were blind to the OSAS severity and the age of the patient.

Subjective Ratings

To obtain data on the perceived quality of life (QOL), each patient managed to complete autonomously the Italian version of the SWAL-QOL [16] before the FEES examination. Depending on the DOSS scores, the cohort of patients was divided in two additional groups: Group A included 26 patients with signs of dysphagia (DOSS scores <6) and Group B included 46 patients without signs of dysphagia (DOSS scores >6).

Statistical Analysis

Statistical tests were performed using SPSS v19.0 (SPSS, Inc., Chicago, IL, USA). For the comparison of PAS, PS, DOSS, and SWAL-QOL scores of patients with moderate and severe OSAS (Groups 1 and 2, respectively) and for the comparison of SWAL-QOL scores of patients with and without signs of dysphagia (Groups A and B, respectively), the nonparametric Mann-Whitney test was used. The same test was also used to assess the difference in the distribution of age, AHI, and BMI scores in the different groups of patients. The nonparametric Fisher test was used to assess the differences in the distribution of sex and signs of dysphagia between the two groups of patients. Spearman's correlation coefficient was used to examine the relationship between the severity of dysphagia and OSAS.

Results

All the patients included in the study were successfully evaluated with a FEES exam and managed to complete, without any help, the Italian version of the SWAL-QOL. The mean apnea–hypopnea index (AHI) score was 38.7 ± 19.3 (range = 17–94). The mean body mass index (BMI) score was 29.9 ± 5.2 (range = 21–43). The mean age, AHI, and BMI scores of patients in Group 1 and Group 2 are reported in Table 1. No differences were found in the distribution of age or BMI scores between the two groups using the Mann-Whitney test. Fisher's test revealed a significant difference in the distribution of sex in the two groups of patients. In particular, there were more males with severe OSAS.

The results of the FEES examination are reported in Figs. 1, 2 and 3 and in Table 3. Forty-six of the 72 recruited patients (64 %) (20/30 in Group 1 and 26/42 in Group 2) presented spillage with the 20-ml liquid bolus. Twenty of the 72 patients (28 %) (8/30 in Group 1 and 12/42 in Group 2) presented piecemeal deglutition in the 10-ml liquid trials. The mean number of swallows per bolus was 1.3 ± 0.5 (range = 1–3). Twenty-six of the 72 patients (36 %) (10/30 in Group 1 and 16/42 in Group 2) presented penetration with the 20-ml liquid bolus. Only two patients experienced aspiration. No differences were found between the two groups of patients upon Fisher's test.

The mean PAS score was 2.1 ± 1.6 (range = 1–7). With respect to the pooling score, 30 of the 72 patients (44 %) (14/30 in Group 1 and 16/42 in Group 2) presented retention, with a mean PS score of 4.8 ± 2.5 with the half cookie trial. In the DOSS examination, 32 of the 72 patients (45 %) presented signs of dysphagia. In Group 1 the mean DOSS score was 5.7 ± 1.1 (range = 4–7) and in Group 2 the mean DOSS score was 6.1 ± 0.9 (range = 5–7). DOSS, PAS, and PS scores with boluses of different textures and volumes are reported in Table 2. No differences were found in the PAS, PS, and DOSS scores between patients with moderate and severe OSAS. No significant correlations were found between AHI and PAS, PS, and DOSS scores on Spearman's test.

Table 1 Demographic characteristics of the enrolled patients

	Group 1	Group 2	*p*	Group A	Group B	*p*
Sex	18M/12F	36M/6F	0.01*	19M/7F	35M/11F	0.49
Age	61.4 ± 8.8 (37–75)	59.2 ± 12.6 (24–75)	0.68	62.9 ± 12.4 (24–75)	57.9 ± 9.7 (37–74)	0.03*
AHI	22.2 ± 3.9 (17–29)	50.4 ± 17.1 (32–94)	0.01*	34.5 ± 16.4 (17–69)	42.1 ± 21.1 (17–94)	0.07
BMI	29.6 ± 5.6 (21–41)	30.1 ± 5.1 (25–43)	0.87	30.3 ± 4.7 (25–40)	29.8 ± 5.8 (21–41)	0.41

Mean ± standard deviation and results of statistical analysis through Mann-Whitney test (for continuous variables) and Fisher's test (for categorical variables) are reported. Ranges are in parentheses

AHI apnea-hypopnea index, *BMI* body mass index

* $p < 0.05$

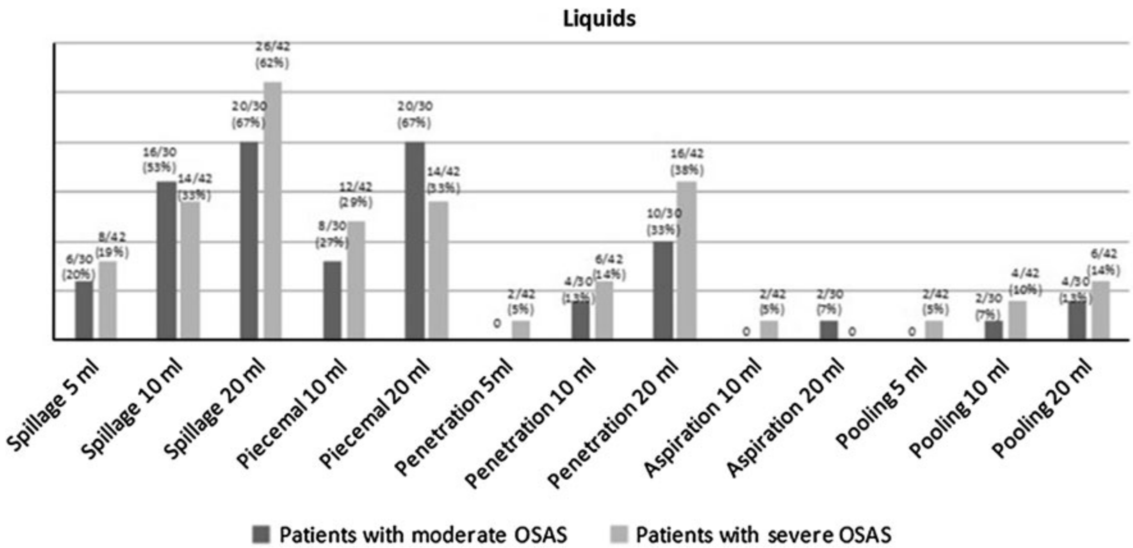

Fig. 1 *Bar graph* representing the signs of dysphagia during FEES examination using liquid textures in patients with moderate (Group 1; $n = 30$) and severe (Group 2; $n = 42$) OSAS. Absolute frequencies and relative frequencies in percentage (*in brackets*) are reported

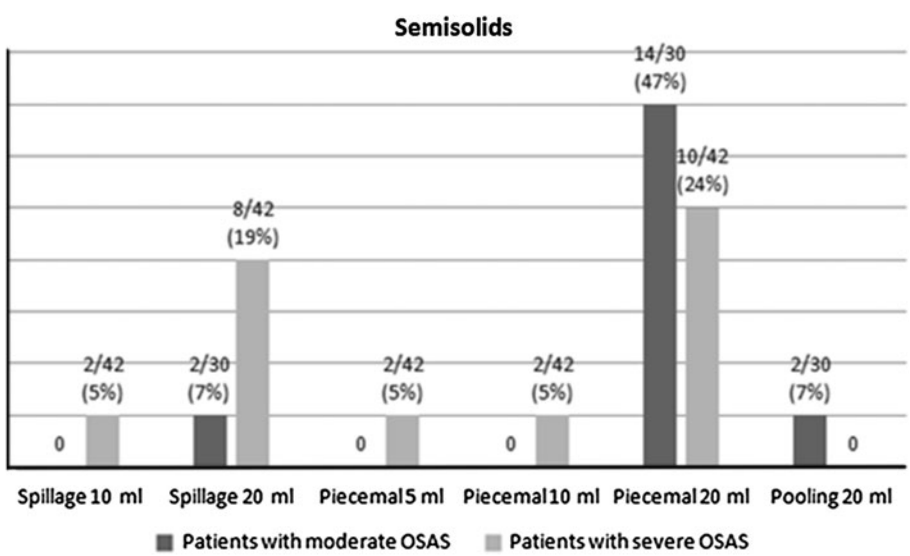

Fig. 2 *Bar graph* representing the signs of dysphagia during FEES examination using semisolid textures in patients with moderate ($n = 30$) and severe ($n = 42$) OSAS. Absolute frequencies and percentage relative frequencies (*in brackets*) are reported

The SWAL-QOL scores for Group 1 and Group 2 are reported in Table 3. The SWAL-QOL score was lower than 80/100 in the Fatigue and Sleep subscales and higher in all other subscales. Differences were found with the Mann-Whitney test between the scores obtained in the General Burden and Food selection subscales ($p = 0.023$ and

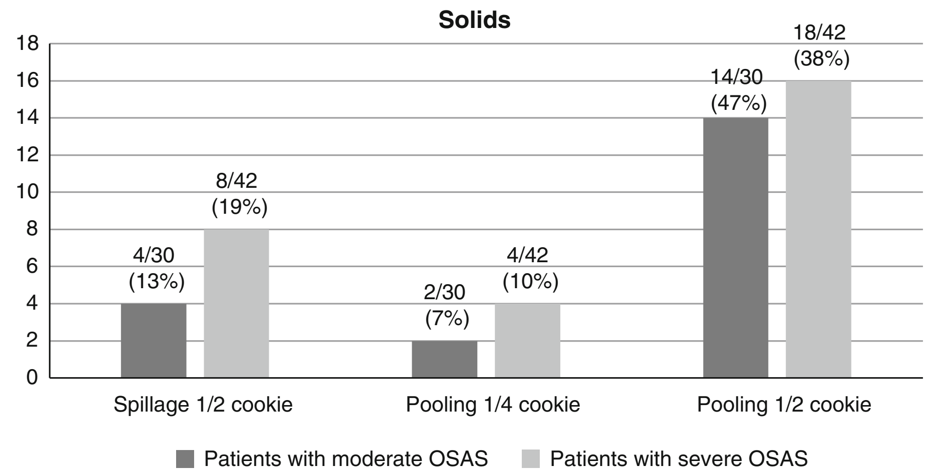

Fig. 3 *Bar graph* representing the signs of dysphagia during FEES examination using solid textures in patients with moderate ($n = 30$) and severe ($n = 42$) OSAS. Absolute frequencies and percentage relative frequencies (*in brackets*) are reported

Table 2 Penetration–aspiration scale (PAS) and polling score (PS) in patients with moderate (Group 1) and severe OSAS (Group 2)

	Group 1	Group 2	*p*
PAS liquids 5 ml	1.0 ± 0.0	1.1 ± 0.4	0.229
PAS liquids 10 ml	1.5 ± 1.3	1.3 ± 0.7	0.526
PAS liquids 20 ml	2.3 ± 1.8	1.9 ± 1.3	0.529
PAS semisolids 5 ml	1.0 ± 0.0	1.0 ± 0.0	1
PAS semisolids 10 ml	1.0 ± 0.0	1.0 ± 0.0	1
PAS semisolids 20 ml	1.0 ± 0.0	1.0 ± 0.0	1
PAS solids ¼ cookie	1.0 ± 0.0	1.0 ± 0.0	1
PAS solids ½ cookie	1.0 ± 0.0	1.0 ± 0.0	1
PS liquids 5 ml	4.0 ± 0.0	4.2 ± 0.8	0.229
PS liquids 10 ml	4.4 ± 1.5	4.3 ± 1.2	0.739
PS liquids 20 ml	4.6 ± 1.8	4.6 ± 1.7	0.939
PS semisolids 5 ml	4.0 ± 0.0	4.0 ± 0.0	1
PS semisolids 10 ml	4.4 ± 1.5	4.0 ± 0.0	0.091
PS semisolids 20 ml	4.6 ± 1.7	4.3 ± 0.9	0.066
PS solids ¼ cookie	5.1 ± 1.9	4.4 ± 1.2	0.057
PS solids ½ cookie	6.1 ± 2.4	5.6 ± 2.1	0.391
DOSS score	5.7 ± 1.1	6.1 ± 0.9	0.451

Values are mean ± standard deviation

0.016, respectively). In particular, patients with severe OSAS scored higher in both of these subscales.

Based on the DOSS score, the cohort of patients was divided in two additional groups. Group A included 26 patients with signs of dysphagia and with a DOSS score between 1 and 5. Group B included 46 patients without signs of dysphagia and with a DOSS score of 6 or 7. The mean age, AHI, and BMI scores and the distribution of gender in Groups A and B are reported in Table 1. No differences were found in the distribution of gender and in AHI and BMI scores between the groups, while patients with signs of dysphagia were significantly older than patients without signs of dysphagia ($p = 0.03$). The SWAL-QOL scores of patients with and without signs of dysphagia are reported in Table 3. Patients with signs of dysphagia scored lower in the General Burden and Symptoms subscales ($p = 0.001$ and 0.005 respectively) of the SWAL-QOL.

Discussion

In the present study, the signs and symptoms of oropharyngeal dysphagia seen with a FEES examination using boluses with different textures and volumes in a large cohort of patients with OSAS of different severity have been analyzed. The results reported here further confirm that patients with OSAS have a subclinical swallowing dysfunction. However, the severity of the dysphagia did not appear to be correlated with the severity of the OSAS. In fact, no differences were found in the FEES examination between patients with moderate and severe OSAS and no significant correlations were found between AHI and PAS, PS, and DOSS scores.

The results of the FEES examination demonstrated that 28 % of patients had piecemeal deglutition with the 10-ml liquid trials and 64 % had spillage with the 20-ml liquid trials. These findings are in agreement with those of previous reports. Valbuza et al. [8] found that 64 % of patients with OSAS displayed premature bolus leakage, though they did not specify with which bolus texture those results were found. Teramoto et al. [4], who studied the time from a bolus injection of distilled water at the suprapharynx to the onset of swallowing (latent time), demonstrated that water-stimulated swallowing reflex is delayed in patients with OSAS compared to control subjects without OSAS. The authors also suggested that this longer latent time could increase penetration and/or aspiration of the bolus in the airways. Jäghagen et al. [5] reported repeated premature bolus leakage down to the level of epiglottis in 51 % of snoring patients, with intermittent premature

Table 3 SWAL-QOL scores in patients with moderate (Group 1) and severe OSAS (Group 2) and in patients with (Group A) or without (Group B) signs of dysphagia

SWAL-QOL	Group 1	Group 2	*p*	Group A	Group B	*p*
GEN BURD	92.2 ± 12.3	98.1 ± 8.7	0.023*	90.1 ± 12.6	98.6 ± 3.4	0.001*
DUR	92.1 ± 11.1	94.3 ± 10.9	0.089	96.9 ± 7.3	91.3 ± 17.2	0.197
DES	88.5 ± 12.2	93.7 ± 14.3	0.155	87.7 ± 14.3	93.6 ± 7.6	0.125
SYM	88.1 ± 8.3	90.1 ± 7.4	0.449	85.5 ± 7.2	91.3 ± 7.8	0.005*
FOOD SEL	94.1 ± 18.3	99.5 ± 5.1	0.016*	93.8 ± 21.7	99.6 ± 2.1	0.516
COM	90.8 ± 17.2	94.3 ± 11.1	0.311	89.2 ± 17.2	94.3 ± 12.2	0.129
FEAR	95.7 ± 8.3	96.1 ± 9.2	0.810	94.6 ± 8.4	96.5 ± 7.8	0.089
MEN	99.2 ± 6.1	98.8 ± 8.7	0.233	97.8 ± 6.5	99.8 ± 0.9	0.096
SOC	100 ± 0.0	100 ± 0.0	1.000	100 ± 0.0	100 ± 0.0	1.000
FAT	78.3 ± 12.6	80.6 ± 11.8	0.230	81.1 ± 13.8	78.8 ± 17.2	0.758
SLEEP	79.3 ± 15.1	77.6 ± 14.5	0.726	78.5 ± 16.9	78.2 ± 23.2	0.565

GEN BURD general burden, *DUR* eating duration, *DES* eating desire, *SYM* symptoms, *FOOD SEL* food selection, *COM* communication, *FEAR* fear of eating, *MEN* mental health, *SOC* social effects, *FAT* fatigue, *SLEEP* sleep

* $p < 0.05$

passage of the bolus further down to the level of the pyriform sinus in 12 % of patients. It is possible that the bolus leakage is caused by a failure in the swallowing reflex triggering. This latter may be dependent by local neuronal damage caused by the snoring vibration trauma [5, 6].

Bolus residue was observed in 44 % of the patients with the solid texture bolus after the propagation wave had passed. This could increase the risk of inhaling food particles into the open airways since the patients are unaware of bolus remnants in the pharynx. Penetration was observed in 35 % of patients with the 20-ml liquid bolus, while aspiration was observed in only two patients. Valbuza et al. [8] found that 55 % of OSAS patients displayed pharyngeal stasis even if no aspiration was observed. In the Jäghagen et al. study [5], bolus residue was observed in 10 % of snoring patients while penetration was found in 7 % of patients. No aspiration below the glottis level was seen in any of the 41 studied subjects. It is possible that the higher percentages of bolus residue and penetration reported in the present study are related to the differences in the volumes of liquid and solid used for the FEES examination. In the Jäghagen et al. study [5], in fact, only volumes of 10 ml were analyzed.

Impairment of pharyngeal sensitivity may increase the risk of bolus stasis and could eventually facilitate penetration. The low frequency of aspiration may explain why the patients with swallowing dysfunction remained asymptomatic. It could also explain why specific instruments such as the SWAL-QOL were not able to identify symptoms of dysphagia in patients with OSAS. Interestingly, the lowest scores (more pathological) were obtained in the Fatigue and Sleep subscales. Even if not specifically related to the swallowing dysfunction, the Fatigue and Sleep subscales more likely were affected in patients with sleep difficulties and daytime sleepiness.

Comparing the SWAL-QOL scales in OSAS patients with and without signs of dysphagia, a small yet significant difference in the Symptoms subscale was found. This is a point of interest for everyday clinical practice; in fact, the Symptoms subscale of the SWAL-QOL investigates symptoms such as cough, choking, oral retention, and nasal regurgitation which could be easily asked about during consultation with OSAS patients. Patients who complain of these symptoms could then be referred to a swallowing clinic.

Our findings further support the hypothesis that OSAS is associated with aberrant pharyngeal function during swallowing. In OSAS patients, the repeated episodes of collapse during sleep are caused by an altered control of the upper-airway patency, but although the mechanisms underlying this impairment are not completely understood [17], there is evidence that in patients with OSAS the upper-airway mucosal sensory function in the oropharynx is impaired [18, 19], possibly because of low-frequency vibration of habitual snoring [19]. This vibration, in fact, has been found to disturb nerve regulation of microcirculation in the soft palate of habitual snorers and some patients with OSAS [20, 21]. Kimoff et al. [18] found that vibratory sensation and two-point discrimination were impaired in the oropharynx but not in the control sites on the lip and hand in OSAS patients and snorers compared with a group of nonsnoring control subjects. Dematteis at al. [20] reported that the impairment of pharyngeal sensitivity, measured by delivering different airflow rates on the soft palate, is correlated with the severity of sleep-disordered breathing. Guilleminault et al. [21] and Nguyen et al. [22]

demonstrated that patients with OSAS had clear impairment of their palatal, laryngeal, and soft palate sensory input, with a significant decrease in two-point discrimination compared to normal subjects.

One can speculate that the upper-airway mucosal sensory defect, on the one hand, could contribute to upper-airway collapse during sleep, and, on the other hand, it may influence the functions that require adequate pharyngeal sensitivity, such as the swallowing reflex. In fact, swallowing relies on adequate pharyngeal sensitivity and function. For this reason local nerve lesions could alter pharyngeal function during swallowing [5] and the normal coordination between breathing and swallowing while awake and asleep [17, 23].

It seems that the risk of developing a swallowing dysfunction, as analyzed with DOSS, increases with the age of the patients. The age of OSAS patients with signs of dysphagia (Group A) was significantly higher than the age of patients without signs of dysphagia (Group B). This finding is not in agreement with those of previous studies. Valbuza et al. [8] observed that the length of time a patient had OSAS and not the age of the patient had a negative impact on swallowing function. However, Jäghagen et al. [5] reported that snoring patients with pharyngeal dysfunction were significantly older than those without dysfunction. Also, Ekberg et al. [9], who with videofluoroscopy evaluated 56 subjects with a mean age of 83 years and without symptoms of dysphagia, reported the presence of oral abnormalities in 63 % and pharyngeal dysfunction in 25 % of the population. One can speculate that age may influence the capacity to compensate for the vibration trauma caused by snoring and this could explain why the age of OSAS patients with and without signs of dysphagia was different.

This study suffers from some limitations. First, no control group was recruited and consequently no comparison between the presence of signs of dysphagia between OSAS patients and asymptomatic subjects was performed. However, these comparisons had been already reported in the literature [5, 8]. In addition, since Jäghagen et al. [5] demonstrated the presence of swallowing abnormalities in snoring subjects, it would be interesting to compare the swallowing characteristics of patients with OSAS with those of snoring subjects.

Finally, assuming that the vibration trauma may be associated with swallowing abnormalities, it would be interesting to evaluate the sleep endoscopy results of patients with OSAS to assess the possible correlation between the presence of signs of dysphagia and the site of airway obstruction.

The present study should be considered a preliminary report on swallowing dysfunction in patients with OSAS of different severity as assessed with a FEES examination and using valid and reliable instruments. Further studies to analyze the mechanism leading to spillage, penetration, aspiration, retention, and piecemeal deglutition are required. In particular, the coordination between swallowing and respiration in OSAS patients with and without signs of dysphagia could contribute to the understanding of the pathophysiology of dysphagia.

In conclusion, patients with OSAS have a subclinical swallowing dysfunction. The severity of this dysfunction is not correlated with the severity of the OSAS. In addition, the patients do not complain of any dysphagia symptoms, probably because of the low frequency of aspiration below the glottis level. However, in about half of the patients studied, the FEES examination demonstrated signs of swallowing impairment. The clinical implications are related to the risk of inhaling food particles into the open airways since the patient is unaware of bolus remnants in the pharynx. Interestingly, in comparing the SWAL-QOL scores obtained in OSAS patients with and without signs of dysphagia (Group A and Group B, respectively), a significant difference in the Symptoms subscale was found. This means that patients with signs of swallowing dysfunction complain of dysphagia symptoms if specifically asked. Since this subscale investigates symptoms that could be easily asked about during consultation of OSAS patients, it should be mandatory for the clinicians involved in the management of OSAS patients to include questions on swallowing during history taking. Patients who complain about these symptoms should than be referred to a swallowing specialist for deeper analysis of the swallowing impairment. The identification of a patient at risk of developing pneumological complications could therefore improve the clinical outcome of the patient with OSAS.

Conflict of interest The authors have no conflicts of interest to declare.

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