Upper Airway Collapse Evaluation in Sleep Disorderd Breathing with Drug Induced Sleep Endoscopy

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Abstract Objective: to assess value of using drug induced sleep endoscopy (DISE) in evaluation of upper airway (UA) collapse in obstructive sleep apnea (OSA) patients and comparing its results with that of traditional evaluation techniques. **Background:** to obtain a better insight into the complex pathophysiology of airway collapse and upgrade treatment success rates while prospectively selecting the most suitable therapeutic option for the individual patient. Airway appreciation in sleep disordered breathing (SDB) patients is often restricted by the fact that the evaluation is static and/or performed during wakefulness, possibly not representing the actual dynamics of airway collapsibility during sleep. **Patient and Methods:**46 patients who were referred for sleep endoscopy and were diagnosed as obstructive sleep apnea hypopnea syndrome (OSAHS) diagnosed by overnight polysomnography. Full ear, nose and throat (ENT) examination was conducted including Muller maneuver (MM), and then DISE was performed by using the flexible rhinopharyngolaryngoscope. **Results**: DISE results are significantly different from MM in diagnosing the level and degree of collapse of upper airway collapse especially in higher degrees of obstruction at the level of oropharynx and hypopharynx, and by using chi square this difference was statistically significant (P value =0.040). **Conclusion**: Most of patients with OSA had upper airway collapse, with different level, degree and pattern of obstruction. DISE is a reliable and an accurate tool of UA assessment during sleep and can give us the best treatment recommendations for OSA patients.

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1. Introduction

Obstructive sleep apnea (OSA) is characterized by interrupted, repeated upper airway narrowing or obstruction occurring during sleep. Nighttime polysomnography is the method of choice to confirm suspected SDB and to verify a diagnosis of OSAHS. **[1]**

Obstructive sleep apnea syndrome is a common disturbance, with a prevalence of 2 % to 4 % in the adult population and an increasing rate of morbidity and mortality **[2].** Pharyngeal collapse during sleep as a result of abnormal constitutional anatomy and loss of muscle tone during sleep are distinctive of OSA, with snoring being a cardinal sign. **[3]**

Airway assessment in SDB patients is often restricted by the fact that the estimation is static and/or performed during wakefulness, possibly not symbolizing the actual dynamics of airway collapsibility during sleep. **[4]**

Obstructive sleep apnea can occur at many levels, and the main regions of dynamic obstruction are the palate and hypopharynx (actually corresponding to the hypopharynx and the retrolingual portion of the oropharynx). **[5]**

Drug-induced sleep endoscopy (DISE) provides more delicate evaluation of the upper airway. Sleep endoscopy is a technique that consists of pharmacologically inducing sleep in a patient to recognize, with the help of a flexible fiberscope and a video recorder, the areas of vibration and collapse in chronic snorers. **[6]**

This study stands upon evaluation of upper airway collapse in Obstructive sleep apnea patients with drug induced sleep endoscopy and comparing its results with that of traditional evaluation techniques.

This eventually aims to improve the quality of care of such patients and avoid unnecessary treatment options.

2. Patients and Methods

A prospective study was conducted at Samannoud General Hospital, department of otorhinolaryngology (ORL) and Menofia University Hospital, Departement of ORL. In the period from December 2015 till January 2017 after approval of the ethical committee of the hospital (Samannoud General Hospital and Menofia University Hospital). The study group consisted of 46 patients who were referred for sleep endoscopy. All had complaints of daytime sleepiness and were diagnosed with OSAHS by nocturnal polysomnography. Full ENT examination was conducted. Then fiberoptic nasoendoscopy is performed with Mullermaneuver. Patients who are surgical candidates undergo DISE. All had previously failed or refused treatment with continuous positive airway pressure (CPAP) and were asking for surgical management. Full explanation of the procedure was given and detailed informed consent was taken, including possibility of temporary tracheostomy.

Inclusion criteria include Patients with a confirmed diagnosis of OSAHS (Apnea hypopnea index: AHI > 10 per hour of sleep) using polysomnography and informed consent including possibility of temporary trachestomy. We exclude unfit patients for general anesthesia, allergic patients to propofol and pregnant women.

Drug Induced Sleep Endoscopy **(**DISE) was performed by using the flexible rhinopharyngolaryngoscopy (11101 RP2, Karl Storz, Germany) in an intervention room by an experienced ENT specialist in close cooperation with the anesthesia department. Repeated bolus infusion of propofol (Braun Melsungen AG, Germany) at 1.5 mg/kg was given to every patient until sleep begins which was also noticed by the start of snoring with close monitoring of the oxygen saturation doing jaw thrust when obstruction or oxygen desaturation occurred.

Once the patient has reached a satisfactory level of sedation, a flexible endoscope (e.g., 3.5 mm) was introduced into the nasal cavity. The nasal passage, nasopharynx, velum, tongue base, epiglottis, and larynx were observed. The levels of snoring and/or obstruction were assessed and selected events were registered on video and stills through a camera (Telecam-C 20212043 PAL, Karl Storz, Germany). Since the obstructive events during sleep apnea/ hypopnea usually occur during inspiration, the images were generally taken in that phase. **[7]**

Statistical Analysis:

It is a prospective randomized clinical trial study. The cases were selected using the simple random sample method putting into consideration the inclusion and exclusion criteria. Data were collected, tabulated and statistically analyzed by using an IBM personal computer with statistical package for the social science (SPSS) version 20 and Epi info 2000 programs. Descriptive statistics included quantitative data presented as mean ($\bar{x}$) and standard deviation (SD), and qualitative data presented as numbers and percentages (%). Chi-squared test (x2) was used to study association between two qualitative variables. P-value of (≤ 0.05) was considered statistically significant.

3. Results

Total 46 cases were enrolled in this study, 24 males and 22 females with ages ranging from 25 to 62 years old. **(table 1)**

Classic ENT evaluation techniques including (anterior rhinoscopy, Modified Mallampati index, tonsil size and uvula assessment) were done to all participants. **(table 2)**

Polysomnographic evaluation of patients during sleep was carried out and the results as shown in **(table 3).**

Apnea hypopnea index (AHI): the mean apnea hypopnea index was 11.8 ± 12.4/h, we found that more than half of the participants showed normal indices (19.5 %), 24 % had mild degree of OSA, 39 % had moderate OSA and 17.4 % had severe OSA.

Lowest oxygen saturation: the mean lowest oxygen saturation during sleep was 70.6 ± 11.9 %, ranging from (49 – 88 %) which means that it was abnormal (< 90 %) in all patients.

Oxygen desaturation index: the mean Oxygen desaturation index was 18.5 ± 9.7 %, ranging from (1 – 40 %). It was abnormal (> 10 %) in 71.7 % of patients.

DISE was done in order to describe the UA collapse during sleep, we will use the NOHL classification system and the degree of obstruction will be demonstrated as follows 0-25% as mild, 25-50% as moderate, 50-75% as moderately severe and 75-100% as severe as shown in **(table 4).**

MM and DISE were performed to all cases, and all subjects demonstrated upper airway obstruction. All patients also showed obstruction at both oropharyngeal and hypopharyngeal levels but with different degrees.

All patients showed no glottic involvement, while differences were noticed between MM and DISE in the assessment of oropharynx, hypopharynx and supraglottis as shown in **(table 5).**

DISE helped us to know not only the degree of obstruction but also its pattern in the oropharynx and hypopharynx which was as follows:

1. Oropharynx: most patients 72.4% had concentric obstruction while 12.5 % had antero - posterior obstruction and 15.1 % had latero-lateral obstruction.
2. Hypopharynx: nearly half of patients 52.2 % had concentric obstruction, 19 % had antero-posterior obstruction and 28.8 % had latero-lateral obstruction.

Table 1: Demographic characteristics of study subjects:

Age		Gender		Smoking status	
(Mean ± SD)*	Range	Males n (%)**	Females n (%)	Non Smokers n (%)	Smokers n (%)
42.06 ± 9.10	25-62	24(52.2%)	22(47.8%)	28(69.9 %)	18(39.1%)

*SD: standard deviation ** number of cases (percentage)

Table 2: Classic ENT evaluation results:

Anterior rhinoscopy:	
Normal rhinoscopy	28 (60.9 %)
Deviated septum	18 (39.1 %)
Hypertrophied inferior turbinates	18 (39.1 %)
Modified Mallimpati index (MMI):	
Score 1	3 (6.5 %)
Score 2	9 (19.5 %)
Score 3	18 (39.1 %)
Score 4	16 (34.8%)
Tonsil size*	
Grade 0	5 (10.9 %)
Grade 1	16 (34.8 %)
Grade 2	14 (30.4 %)
Grade 3	11 (24 %)
Grade 4	0 (0 %)
Uvula assessment	
Absent uvula	3 (6.5 %)
Normal uvula	24 (52.2 %)
Long uvula	19 (41.3 %)

*tonsil size is assessed according to Freidman staging for tonsil size

Table 3: Polysomnography results:

Apnea hypopnea index (AHI)	
Normal	9 (19.5 %)
Mild OSA*	11 (24 %)
Moderate OSA	18 (39 %)
Severe OSA	8 (17.4 %)
Lowest oxygen saturation	
Normal > 90 %	0 (0 %)
Abnormal < 90 %	66 (100 %)
Oxygen desaturation index	
Normal < 10 %	13 (28.3%)
Abnormal > 10%	33 (71.7 %)

*OSA: obstructive sleep apnea

Table 4: Results of DISE*:

Degree of obstruction	**Number of patients**
NOSE	
0 – 25 %	28 (60.9%)
25 – 50 %	12 (26%)
50 – 75 %	6 (13%)
75 – 100 %	0 (0%)
Oropharynx	
0 – 25 %	3 (6.5 %)
25 – 50 %	8 (17.4 %)
50 – 75 %	19 (41.3 %)
75 – 100 %	16 (34.8 %)
Hypopharynx	
0 – 25 %	11 (23.9 %)
25 – 50 %	5 (10.8 %)
50 – 75 %	13 (28.3 %)
75 – 100 %	17 (36.9 %)
Larynx	
Glottic	0 (0%)
Supraglottic: positive	9 (19.6 %)
negative	37 (80.4 %)

*DISE: drug induced sleep endoscopy

Table 5: Comparison between results of Muller maneuver and DISE:

	MM†	DISE	P value‡
Oropharynx:			
Degree of obstruction:			
0 – 25 %	13 (28.3 %)	3 (6.5 %)	
25 – 50 %	29 (63 %)	6 (13 %)	0.040*
50 – 75 %	4 (8.6 %)	19 (41.3 %)	
75 – 100 %	0 (0 %)	18 (39.2 %)	
Hypopharynx:			
Degree of obstruction:			
0 – 25 %	18 (39.2 %)	9 (19.6 %)	
25 – 50 %	24 (52 %)	5 (10.8 %)	0.000*
50 – 75 %	4 (8.7 %)	13 (28.3 %)	
75 – 100 %	0 (0 %)	19 (41.3 %)	
Larynx:			
Supraglottic:			
positive	9 (19.6 %)	9 (19.6 %)	0.06**
negative	37 (80.4 %)	37 (80.4 %)	

†MM: Muller maneuver ‡ p: probability of error
* Significant at p value ≤0.05 ** Insignificant

4. Discussion

Frequently, UA collapse occurs at the same time at different section levels. Recognizing the site and the dynamic pattern of obstruction is mandatory in curative decision- making, and especially if a surgical therapy choice is taken into account. The main pathophysiological event of OSAHS is the apneic collapse of the UA. The more recurrent sites of pharyngeal collapse are soft palate, lateral pharyngeal walls, palatine tonsils, tongue base and the larynx may be involved at epiglottis level in most cases. **[8]**

This study showed that most of the patients had obstruction at the oropharyngeal level, 80.5% (n=37/46) of the patients showed from (50-100%) obstruction at the level of the oropharynx according to the NOHL classification (table 4). This was consistent with Eichler C who showed that the more recurrent site of obstruction seen by DISE was the velum (including soft palate, uvula, tonsils, and nearby sections of pharynx) with 93.8% (n=91). Bachar G showed an obstruction rate of 89% (n=47/53) at the level of soft palate. Abdullah VJ divided the sites of obstruction into soft palate and tonsils with an obstruction rate at the palatal level of 87% (n=26/30) and at the tonsil level of 40% (n=12/30). Nearly all patients studied by Steinhart H showed a collapsibility of over 80% on the level of velum. **[9, 10]**

The second most commonly noted obstruction level at high grades of obstruction in our patient group was the hypopharynx in 69.5% (n=32/46) (table 12). Our results were consistent with those of Eichler C who noted that 76.3 %(n=74) of all patients had obstruction at the same level, second in order after the oropharyngeal level. **[11]**

Only 19.6% (n=9/46) of our patients showed supraglottic obstruction due to flappy epiglottis while Eichler C found 32.0% (n=31) with an obstruction at the epiglottis level. **[9, 10]**

We found also that all the patients (100%) had multiple level obstruction that could not have been suspected during the exploration of the awake patients. twelve patients (26%) had severe obstruction (75-100%) at both oropharyngeal and hypopharyngeal levels at the same time (two levels of obstruction). eight patients showed moderately severe obstruction (50 – 75 %) in the oropharynx, different degrees of obstruction in the hypopharynx and they also had flappy epiglottis (three levels of obstruction). For these patients (three levels of obstruction including the hypopharynx) surgery isn't the recommended treatment regimen and they should be placed on CPAP, these findings couldn't be detected by the classic ENT evaluation techniques.

The results of our study were in agreement with Carrasco M who didn't find a correlation between the screening of the upper airway carried out on the awake patient by MM and the findings of DISE, suggesting that they cannot depend on the findings of MM without DISE. **[12]**

Conclusion

Upper airway collapse is an important cause of obstruction in OSA patients that can't be sufficiently estimated by classic ENT evaluation methods including MM aren't sufficient or reliable for UA evaluation as they don't describe the dynamic collapse of the UA during sleep, so, they may give us incomplete assessment and even faulty treatment recommendations.

Most of patients with OSA had lateral pharyngeal wall collapse, with different level, degree and pattern of obstruction. Most of the patients had obstruction at the oropharyngeal level; the most frequent site of obstruction visualized by DISE was the velum.

DISE is a reliable and an accurate tool of UA assessment during sleep and can give us the best treatment recommendations for OSA patients in addition to the avoidance of unnecessary surgical interventions especially in multilevel obstruction patients.

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