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THE COMPARISON OF CONFIGURATION, DEGREE AND SITES OF OBSTRUCTION IN PATIENTS WITH SLEEP DISORDERED BREATHING: EXAMINATION USING DRUG-INDUCED SLEEP ENDOSCOPY, MUELLER MANEUVER AND POLYSOMNOGRAPHY

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ABSTRACT

Objective: The purpose of this study is to evaluate the location, configuration, and degree of differences in upper airway obstruction between the Mueller Maneuver (MM) and Drug-induced sleep endoscopy (DISE), thus acquiring a better diagnostic value for SDB patients.

Methods: A cross-sectional and analytical descriptive study using retrospective secondary data to evaluate the location, configuration and degree of upper airway obstruction in SDB subjects using the Mueller Maneuver and DISE. Polysomnography (PSG) type 2 was used to determine the SDB degree.

Results: Subjects with SDB non-Obstructive sleep apnea (OSA) and OSA show a multilevel obstruction with a different location and configuration due to the various risk factors, such as nasal congestion, laryngopharyngeal reflux, obesity and menopause.

Conclusion: Statistical differences in upper airway obstruction configuration between MM and DISE were found in the level of the velum (p=0,036), oropharynx (p<0,001) and epiglottis (p=0,036) and were also found in the obstruction degree of the velum, oropharynx, tongue base and epiglottis with p=0,002; p<0,001; p<0,001 and p<0,001. No statistical difference was found on the lowest oxygen saturation between PSG and DISE (p=0,055).

Keywords: Drug-induced Sleep Endoscopy (DISE), Mueller Maneuver, Obstructive Sleep Apnea (OSA), Polysomnography, Sleep Disordered Breathing (SDB)

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INTRODUCTION

Sleep-disordered breathing (SDB) is a spectrum of abnormalities in breathing during sleep. The characteristic of SDB is the presence of a partial or total upper airway obstruction resulting in intermittent pauses in breathing in the form of apnea (total), hypopnea (partial), or just airflow limitation.

Various questionnaires demonstrate a history of sleep complaints, such as the Epsworth Sleepiness Scale (ESS) and the STOP-BANG questionnaire explore the risk factors for sleep disorders. The Nasal Obstruction Symptom Evaluation (NOSE) score, Reflux Symptoms Index (RSI), Reflux Finding Score (RFS). Mueller's Maneuver (MM) examines the active muscle control tone; thus, this maneuver is not representative of the patient's sleeping condition. Polysomnography (PSG) is a gold standard for assessing breathing pattern abnormalities during sleep with many parameters also conducted in this study. Drug-induced sleep endoscopy (DISE) is an actual observation that can assess the dynamics of the upper airway obstruction that occur during sleep. DISE can determined the location, configuration and degree of obstruction at the velum, oropharynx, tongue base or epiglottis (VOTE) or at a combination of these.

The aim of this cross-sectional study using retrospective data is to analyze and compare the location, configuration and degree of airway obstruction by examining MM, DISE and PSG in cases of SDB in 46 adult patients. Nasal obstruction, laryngopharyngeal reflux, tonsil hypertrophy, obesity and menopause were also found to be risk factors of SDB in this study.

MATERIALS AND METHODS

Methods

A cross-sectional and analytical descriptive study using retrospective secondary data from the Bronchoesophagology Division of the ORL-HNS Department FMUI/CMGH was performed to evaluate the difference in the location, configuration and degree of upper airway obstruction in SDB subjects using the Mueller Maneuver (MM) and DISE on 46 subjects. The STOP-BANG questionnaire was used to screen patients and determine the risk factor of SDB. All subjects must have PSG data as a gold standard diagnosis as well as MM and DISE videos and data. The exclusion criteria include incomplete medical records, poor polysomnography data and/or a poor MM or DISE video.

One of the criteria for this study required the age of the research subject to be ≥18 y. In this research, studied 46 subjects, 23 men and 23 women, with a diagnosis of SDB. DISE examination is performed in the operating room accompanied by an ORL-HNS Broncho-Esophagology consultant and an anesthesia specialist. The secondary data (the DISE results) are evident based on the results of the operation report and are read separately at the time by an ORL-HNS specialist guidance Broncho-Esophagology consultant.

Interrater agreement using Kappa score found an almost perfect score (κ>0.81) and substantial score (κ>0.61–0.80) in both configuration and degree of obstruction using VOTE classification in both MM and DISE. PSG type 2 was measured using SOMNOtouch RESP applied to each subject.

SPSS 22.0 software (IBM, Armonk, NY, USA) was used for the statistical analysis. Data were compared using a sample paired t-test, and a value of *p*<0.05 was considered to indicate statistical significance.

RESULTS

There were significant differences in the configuration of upper airway obstruction between MM and DISE as high as the velum area (p = 0.036), oropharynx (p<0.001) and epiglottis (p = 0.036). Fig. 1 shows the DISE evaluation using VOTE (velum, oropharynx, tongue base, epiglottis) classification [1]. Each patient has undergone MM and DISE using this classification to see the collapse pattern and degree of obstruction when awake and asleep.

Table 1: Upper airway obstruction configuration differences in MM and DISE

			DISE (n, %)				
		Configuration	NC	C	AP	LL	*P*-value
MM	Velum	NC	0 (0)	2 (4,3)	0 (0)	0 (0)	*p* 0,036*
		C	0 (0)	16 (34,7)	12 (26,0)	0 (0)	
		AP	0 (0)	2 (4,3)	9 (19,5)	0 (0)	
		LL	0 (0)	1 (2,2)	4 (8,6)	0 (0)	
	Oropharynx	NC	0 (0)	7 (15,2)	2 (4,3)	5 (10,8)	*p*<0,001*
		C	0 (0)	11 (23,9)	2 (4,3)	2 (4,3)	
		AP	2 (4,3)	0 (0)	2 (4,3)	0 (0)	
		LL	0 (0)	3 (6,5)	2 (4,3)	8 (17,3)	
	Tongue base	NC	10 (21,7)	2 (4,3)	12 (26)	6 (13,0)	*p* 0,621*
		C	0 (0)	1 (2,2)	2 (4,3)	1 (2,2)	
		AP	1 (2,1)	0 (0)	4 (8,6)	0 (0)	
		LL	2 (4,3)	0 (0)	4 (8,6)	1 (2,1)	
	Epiglottis	NC	19 (41,3)	0 (0)	17 (36,9)	1 (2,2)	*p* 0,036*
		C	0 (0)	0 (0)	0 (0)	0 (0)	
		AP	1 (2,2)	2 (4,3)	5 (10,8)	0 (0)	
		LL	1 (2,2)	0 (0)	0 (0)	0 (0)	

*Analysis using *Chi Square,* 0 = No Obstruction, 1 = Partial Obstruction, 2 = Total Obstruction, NC = Not Collapsed, C = Concentric, AP = Anteroposterior, LL = Laterolateral

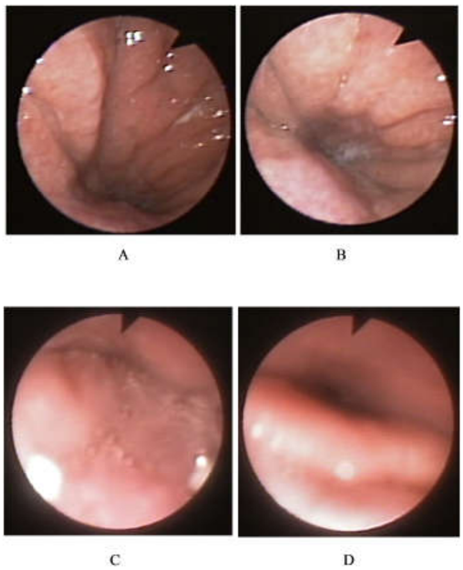

Fig. 1: DISE evaluation using VOTE classification. A) Collapsed concentric velum. B) Collapsed concentric oropharynx. C) Collapsed AP tongue base. D) Collapsed AP epiglottis

Upper airway obstruction degree differences in MM and DISE

The differences in upper airway obstruction degree between MM and DISE are shown in table 2.

The degree of blockage is based on categories 0, 1 and 2. Category 0 refers to no blockage, category 1 to a partial blockage, and category 2 to a total blockage.

Table 2: Upper airway obstruction degree differences in MM and DISE

n (%)	DISE n (%)				*P*-value
MM	Velum	0	1	2	*p* 0,002*
	0	0 (0)	0 (0)	2 (4,3)	
	1	0 (0)	6 (13,0)	18 (39,1)	
	2	0 (0)	5 (10,8)	15 (32,6)	
	Oropharynx	0	1	2	*p*<0,001*
MM	0	0 (0)	2 (4,3)	11 (23,9)	
	1	1 (2,1)	12 (26)	9 (19,5)	
	2	1 (2,1)	2 (4,3)	8 (17,3)	
	Tongue base	0	1	2	*p*<0,001*
MM	0	11 (23,9)	10 (21,7)	9 (19,5)	
	1	3 (6,5)	9 (19,5)	4 (8,6)	
	2	0 (0)	0 (0)	0 (0)	
	Epiglottis	0	1	2	*p*<0,001*
	0	20 (43,4)	5 (10,8)	12 (26)	
MM	1	2 (4,3)	4 (8,6)	3 (6,5)	
	2	0 (0)	0 (0)	0 (0)	

* Result analysis data using test *paired sample t-test*

Table 3: Configuration and location of upper airway obstruction (DISE) based on the RDI (PSG)

Velum					
	Non-Collapsed	Concentric	Anteroposterior	Laterolateral	
SDB non OSA	0 (0)	5 (38,4)	8 (61,5)	0 (0)	n = 13
Mild OSA	0 (0)	8 (44,4)	10 (55,5)	0 (0)	n = 18
Moderate OSA	0 (0)	3 (30)	7 (70)	0 (0)	n = 10
Severe OSA	0 (0)	5 (100)	0 (0)	0 (0)	n = 5
Oropharynx					
	Non-collapsed	Concentric	Anteroposterior	Laterolateral	
SDB non OSA	2 (15,3)	4 (30,7)	3 (23,07)	4 (30,7)	n = 13
Mild OSA	0 (0)	6 (33,3)	5 (27,7)	7 (38,8)	n = 18
Moderate OSA	0 (0)	6 (60)	0 (0)	4 (40)	n = 10
Severe OSA	0 (0)	5 (100)	0 (0)	0 (0)	n = 5
Tongue base					
	Non-collapsed	Concentric	Anteroposterior	Laterolateral	
SDB non OSA	4 (30,7)	0 (0)	8 (61,5)	1 (7,6)	n = 13
Mild OSA	5 (27,7)	1 (5,5)	9 (50)	2 (11,1)	n = 18
Moderate OSA	4 (40)	1 (10)	2 (20)	2 (20)	n = 10
Severe OSA	0 (0)	1 (20)	3 (60)	1 (20)	n = 5
Epiglottis					
	Non-collapsed	Concentric	Anteroposterior	Laterolateral	
SDB non OSA	5 (38,4)	1 (7,6)	7 (53,8)	0 (0)	n = 13
Mild OSA	7 (38,8)	1 (5,5)	9 (50)	1 (5,5)	n = 18
Moderate OSA	6 (60)	0 (0)	4 (40)	0 (0)	n = 10
Severe OSA	3 (65)	0 (0)	2 (43)	0 (0)	n = 5

Note: SDB non OSA: RDI<5, Mild OSA: RDI 5–15, Moderate OSA: 15-30, Severe OSA ≥30

Configuration and location description in upper airway obstruction in DISE based on the respiratory disturbance index (RDI)

The PSG parameter description of RDI is associated with the configuration and location of the DISE examination of the upper airway obstruction in each area using VOTE classification, as listed in table 3.

DISCUSSION

One of the criteria for this study required the age of the research subject to be ≥18 y to avoid bias due to age factors that affect the structure of the upper airway. In children, there are differences in airway structure, such as larger head size, greater tongue proportion, different epiglottis shape and different attachment of vocal cords. In this research, studied 46 subjects, 23 men and 23 women, with a diagnosis of SDB.

There was a significant difference in upper airway obstruction configuration between MM and DISE in velum ($p = 0.036$), oropharynx ($p<0.001$) and epiglottis ($p = 0.036$). Even though the base area of the tongue did not show any significant difference, from the evident obtained, it was seen that the configuration changes from no collapse in MM to the anteroposterior configuration on the DISE were seen in 12 subjects (26%).

MM examination is a subjective examination because it is very dependent on the examiner's skills and the patient's ability to perform the maneuver in the form of the inverse Valsalva. MM cannot be repeated because it causes discomfort during the procedure and can interfere with the dynamics of collapse. Rombaux *et al.*, as quoted by Soares *et al.* [2], mentions that to reduce the subjectivity of Mueller's examination, a pressure of-20 cm H2O is required when the maneuver is performed. Pressure testing is difficult to apply because many patients are unable to perform the inverse Valsalva to the pressure suggested by the consensus, so the results are inconsistent [2].

There are significant differences in our study in the collapsed configuration in MM and DISE measurement. In a study conducted by Jung *et al.* [3], Soares *et al.* [2] with overall subjects representing severe OSA showed no significant difference in the collapsed configuration at MM and DISE, Jung's study found excellent Kappa between MM examination and DISE [3]. Degrees of RDI is a factor that distinguishes the results of this study, Jung *et al.* [4] whom only used a heavy degree OSA subject while in this study, there was a significant difference between the upper airway obstruction configuration based on MM and DISE examinations. Subjects in this study were a combination of subjects with various degrees of OSA, include SDB non-OSA, mild OSA, moderate OSA and severe OSA; thus configuration changes were more likely to occur in this study. There is a significant difference between MM and DISE in the oropharynx and velum area in this study, which can also be due to 1) the inconsistency in generating a negative pressure in MM (because it depends on the ability of the patient) or 2) the differences in the characteristics of the study patients, such as age, BMI, comorbidities, menopausal status and degree of RDI. Yegin *et al.* [4] also showed a low association rate between MM and DISE in the velum and oropharynx areas (Kappa value = 0, 1348-0.1555 and 0.414).

This study also found no significant difference in the configuration between MM and DISE in the base area of the tongue. This can be caused, first, because the majority of patients, as many as 44 subjects (95.6%), have Friedman Tongue Position (FTP), which is quite homogeneous in the 3rd and 4th degree. Secondly, there is a protective effect of the genioglossus muscle that ensures there is no change in the configuration of collapse at the base of the tongue, and the anteroposterior configuration is a normal collapse pattern that can be found at the base of the tongue, which is also seen in Sihombing study [5].

In the epiglottis area, there are also significant differences in configuration between MM and DISE. There were 17 subjects (36.9%) with collapsed AP configurations found in DISE but not found in MM. This can happen because on a subject with epiglottic collapsed there are 1) Arytenoid/redundant edema, which is caused by laryngopharyngeal reflux, causing collapse during DISE but not seen in MM or 2) Occult laryngomalacia—state-dependent laryngomalacia that occurs during sleep [6].

Upper airway closure degree differences in MM and DISE

The difference in the upper airway obstruction degree in MM and DISE is assessed according to categories 0, 1 and 2. Category 0 is used if there is no obstruction (0-25%), category 1 if there is a partial blockage (26-75%), and category 2 if there is a total blockage (≥76%)[7]. This study found significant differences in the upper airway obstruction degree between MM and DISE in the whole area (velum $p = 0.002$, oropharynx $p<0.001$, tongue base $p<0.001$ and epiglottis $p<0.001$), which corresponds to the research hypothesis (table 3). This is in accordance with the hypothesis of this study that there is a difference of the upper airway obstruction degree that occurs between MM and DISE. It shows that MM is not representative for assessing upper airway obstruction degree during sleep because of the muscle tone differences that occur during sleep compared to the movement of active muscle tone when MM is performed.

From the results (table 3) of the DISE examination performed on 13 subjects with mild non-OSA and OSA SDB, in the velum area, concentric collapsed configuration are more common in non-obese subjects (10/13 subjects). In contrast, this study also found that patients with severe OSA (5 subjects) had more concentric velum collapses in obese patients (4/5 subjects). This indicates that concentric velum collapse does not only occur in severe OSA, but can be found in non-OSA and mild OSA. Furthermore, concentric velum collapse, besides being found in obese subjects, can also be found in non-obese subjects. Although research conducted by Ravesloot *et al.* showed that anteroposterior collapse is usually associated with a lower BMI [7].

Configuration description and obstruction location in the upper airway (dise) based on the *respiratory disturbance index/rdi (PSG)*

Configuration description and location of upper airway obstruction using VOTE classification associated with the PSG parameter using the Respiratory Disturbance Index (RDI) categorizes as SDB non-OSA, mild OSA, moderate OSA, and severe OSA. Collapsed configuration was identified as anteroposterior, laterolateral, and concentric type and measured in each level of VOTE.

In mild non-OSA and OSA SDB, anteroposterior collapse is found at the base of the tongue and epiglottis. Ninety percent of the subjects also had symptoms of nasal obstruction. According to Starling's Law, nasal obstruction will result in negative intraluminal pressure in the lower airway area. This causes narrowing of the oropharyngeal cavity in people who have predisposing factors for nasal obstruction. This effect is also aggravated in the supine position, because of the increase in nasal resistance that occurs due to the mechanism of active postural reflexes and decreased hydrostatic pressure on the nasal venous circulation, which results in velum collapse with anteroposterior and concentric configurations as well as the collapse of the epiglottis; thus, causing upper airway obstruction SDB in non-OSA and mild OSA subjects.

Upper airway obstruction configuration can vary in each area depending on anatomic risk factors and the condition of each individual. VOTE classification using DISE examination can see multilevel collapse in 95.5% of patients with OSA [7, 8]. OSA patients have velopharyngeal and oropharyngeal collapse, which are more significant than patients who so not have OSA [7,8]. Complete concentric collapsed (CCC) is associated with a patient's OSA. CCC is considered a predictor of negative values, and the management of patients with CCC is more difficult than other configurations. Kastoer *et al.*[9] stated that with increasing OSA degrees, more CCC would appear. It was important to evaluate this with DISE to provide predictors of subsequent management values. Their study was in accordance with the results of this study, which showed that there was concentric collapse in severe OSA in the velum and oropharynx areas. In severe OSA subjects, the type of configuration in velum and oropharynx are mainly concentric, in the level of base of the tongue mainly found anteroposterior collapsed configuration, and the epiglottis level is not collapsed. As many as 97.8% of the study subjects had nasal blockage that was rated with increasing of Nasal Obstruction Symptom Evaluation Score (NOSE) score. Increase nasal resistance causing bigger upstream pressure thus causing the increase of intraluminal negative pressure in the airway as seen in a concentric collapsed configuration in velum and oropharynx area.

Significant differences were found in the upper airway obstruction configuration between MM and DISE in velum (p=0.036), oropharynx (p<0.001) and epiglottis (p=0.036). There was a significant difference in the upper airway obstruction degree using MM and DISE found in velum (*p* 0,002), oropharynx, tongue base and epiglottis (*p*<0,001). Subjects with SDB non-OSA and mild OSA can also show multilevel blockages with different configurations. The degree of RDI is not always related to the configuration of upper airway obstruction.

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AUTHORS CONTRIBUTIONS

All the author have contributed equally.

CONFLICT OF INTERESTS

There was no conflict of interest in this study.

REFERENCES

1. Abdullah VJ, Koutsourelakis I, Ravesloot M, Lee DL, Ha SC, de Vries N, *et al.* Drug-induced sleep endoscopy. Advanced surgical techniques in snoring and obstructive sleep apnea. San Diego: Plural Publishing; 2013. p. 43–66.
2. Soares MC, Sallum AC, Gonçalves MT, Haddad FL, Gregório LC. Use of Muller's maneuver in the evaluation of patients with sleep apnea: a literature review. Brazilian J Otorhinolaryngol 2009;75:463–6.
3. Jung AR, Koh TK, Kim SJ, Lee KH, Cho JS, Kim SW. Comparison of area and degree of upper airway obstruction by Müller's maneuver and drug-induced sleep endoscopy in obstructive sleep apnea patients. Auris Nasus Larynx 2017;44:57:1–5.
4. Yegïn Y, Çelik M, Kaya KH, Koç AK, Kayhan FT. Comparison of drug-induced sleep endoscopy and Müller's maneuver in diagnosing obstructive sleep apnea using the VOTE classification system. Braz J Otorhinolaryngol 2017;83:445–50.
5. Sihombing CR. Obstructive sleep apnea prevalence in "X" taxi driver in jakarta with snoring and correlate risk factor. Cipto Mangunkusumo Hospital; Jakarta; 2008.
6. Oomen KP, Modi VK. Occult laryngomalacia resulting in obstructive sleep apnea in an infant. Int J Pediatr Otorhinolaryngol 2013;77:1617–9.
7. Ravesloot MJ, de Vries N. One hundred consecutive patients undergoing drug-induced sleep endoscopy: results and evaluation. Laryngoscope 2011;121:2710–6.
8. Phillips NM, Haesler E, Street M, Kent B. Post-anaesthetic discharge scoring criteria: a systematic review. JBI Database Systematic Reviews Implementation Reports 2011;9:1679–713.
9. Kastoer C, Benoist LB, Dieltjens M, Torensma B, de Vries LH, Vonk PE, *et al*. Comparison of upper airway collapse patterns and its clinical significance: Drug-induced sleep endoscopy in patients without obstructive sleep apnea, positional and non-positional obstructive sleep apnea. Sleep Breathing 2018;22:939–48.