Zagazig University Medical Journal
www.zumj.journals.ekb.eg

https://doi.org/10.21608/zumj.2024.322362.3587 Volume 30, Issue 9, December. 2024

Manuscript ID: ZUMJ-2409-3587
Doi:10.21608/ZUMJ.2024.322362.3587

ORIGINAL ARTICLE

Upper Airway Collapse during Nasopharyngoscopy (Muller's Maneuver) in Egyptian Adult patients with Obstructive Sleep Apnea

Sohaylla Musad Lotfy Abdellatif [1*], Amal Saeed Quriba[2], Ashraf Elsayed Elshora [3], Elham Magdy Hassan [2], Nasser Labeb Al Nakeb

[1] Department of E.N.T., Zagazig University Hospitals, Zagazig, Egypt
Department of E.N.T. Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt
Department of Chest Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt

***Corresponding author:**
Sohaylla Musad Lotfy Abdellatif

Email:
sollymusad@gmail.com

Submit Date: 19-09-2024
Accept Date: 24-09-2024

ABSTRACT

Background: A large percentage of the population suffers from obstructive sleep apnea (O.S.A.). Obesity, anomalies in the anatomy of the upper airway, and hormonal impacts are all factors that can predict the occurrence of O.S.A. This work aimed to describe the different levels and patterns of collapse during nasopharyngoscopy (Muller's maneuver) among patients with OSA.

Methods: This cross-sectional research involved 62 cases diagnosed as obstructive sleep apnea who underwent fibro-optic nasopharyngoscopy in the phoniatric unit, E.N.T. department, faculty of Medicine, Zagazig University, from August 2023 until August 2024.

Results: Apnea hypopnea index ranged from 5.3 to 110, with a mean of 33.75. Minimum oxygen saturation ranged from 40 to 93%, with a mean of 76.31%. The commonest pattern of retropalatal closure was concentric in 59.7%, while 66.1% of patients had a lateral obstruction in the retro-laryngeal part, and 61.3% had no closures in the hypopharyngeal part. The mean grades of closure of the retropalatal and retrolaryngeal parts were 76.05% and 67.74%, respectively. The median grade of closure of the hypopharyngeal part was 0%.

Conclusion: Muller's maneuver could be crucial in identifying the level, pattern, and grade of upper airway obstruction, which will serve as the basis for the management plan and type of surgery.

Keywords: O.S.A., Muller Maneuver, nasopharyngoscopy, Upper Airway collapse

INTRODUCTION

Obstructive sleep apnea (O.S.A.) is characterized by recurrent episodes of airway narrowing or obstruction while sleeping. When airflow becomes restricted, the body reacts by waking up the brain and sympathetic nervous system, which in turn disrupt gas exchange and cause symptoms like oxygen desaturation, hypercapnia, and disturbed sleep [1].

People with sleep apnea are known to snore loudly, wake up gasping for air or choking, wake up multiple times during the night, and feel exhausted even after receiving enough sleep. Additionally, the severity of the condition is associated with increased frequency and severity of symptoms such as dry throat, headaches, and daytime sleepiness, which can impact daily activities such as watching television, driving, and working [2].

Although polysomnography (PSG) is the most reliable method for diagnosing O.S.A. and determining its severity, it does not reveal anything about the apnea's physiopathology. From a surgical perspective, it is unfortunate that P.S.G. cannot reveal the location of the blockage or the pattern of airway collapse. Consequently, a plethora of diagnostic tools and techniques have been created. When diagnosing O.S.A., the standard method of looking at the upper airway anatomy is via a fibro-optic nasopharyngoscopy examination. These individuals' prognosis and treatment planning depend critically on the detection of collapse zones [3].

The most crucial aspect of evaluating O.S.A. is conducting a thorough clinical examination of the entire airway in order to identify blockage locations with high accuracy. The majority of the treatment procedures for sleep apnea have focused on treating specific areas. However, there are some that aim to enlarge the upper airway or maintain the airway patent to avoid collapse. So, bad things can happen if the places of collapse aren't correctly identified [4].

To find the points of collapse in the upper respiratory tract (URT) of awake patients, whether they are sitting or supine, the most common and straightforward examination procedure is Muller's maneuver [5]. Muller maneuver-induced pharyngeal collapse is strongly associated with OSAS severity, and the procedure seems to have been confirmed in sleep apnea [6].

The upper airway caliber in obstructive sleep apnea is affected by several anatomical factors, such as The most common cause of upper airway obstruction during sleep is the fact that the pharynx is not rigidly supported anywhere other than at its two ends, the larynx and the very top and very bottom. As a result, the area of the pharyngeal cross-section will change depending on the pressure within the lumen [7]. Abnormal upper airway anatomy, resulting in a smaller cross-sectional area, is an important factor contributing to OSA [8].

Pharyngeal collapse during sleep occurs most commonly in the retropalatal region. This segment of the upper airway is most prone to collapse because it is the narrowest part of the airway and has the greatest compliance. Airway obstruction may also occur in the retrolingual, hypopharyngeal, and epiglottic regions [9].

Volumetric M.R.I. studies of soft tissues, such as the tongue, parapharyngeal fat pads, and enlarged lateral pharyngeal walls, have been shown to significantly impact the airway lumen in obstructive sleep apnea [10].

The upper airway can become restricted due to a diminutive maxilla, a high and narrowed palatal arch, and a short jaw that is retro positioned. The relationship of tongue volume to jaw size or craniofacial restriction has been shown to correlate with the severity of O.S.A. in both obese and non-obese subjects [11]. So, this study aimed to determine the relevance of the pattern and grade of collapse in relation to the upper airway levels.

METHODS

This cross-sectional research involved 62 cases diagnosed with obstructive sleep apnea who underwent fibro-optic nasopharyngoscopy in the phoniatric unit, E.N.T. department, faculty of medicine, Zagazig University, from August 2023 until August 2024. All participants provided written informed consent, and the research ethical committee of the Faculty of Medicine, Zagazig University, approved the study. The research was carried out in accordance with I.R.B. #: 10919-9-7-2023, which is the code of ethics for studies involving human subjects as established by the World Medical Association (Declaration of Helsinki).

Inclusion criteria: All patients with Apnea Hypopnea Index (AHI) ≥ 5/h according to P.S.G. results; aged more than 18 years from both sexes.

Exclusion criteria: We excluded all cases who had P.S.G. results showing AHI < 5/h; patients with central sleep apnea; patients with mixed sleep apnea; patients with other known comorbidities that cause respiratory problems; and patients with known craniofacial or maxillofacial syndromes.

All patients were subjected to the following: Full history taking, emphasizing O.S.A. symptoms as symptoms like hypersomnia, difficulties paying attention when awake, loud snoring, and gasping for air when sleeping or waking up with a dry mouth. STOP BANG Questionnaire, Epworth Sleepiness Scale (Arabic version), and Berlin Questionnaire (Arabic version) were scored [12].

P.S.G.: In the evening, the patient came to the sleep lab. The SOMNOmedics GmbH facility is located at Am Sonnenstuhl 63, D-97236 Randersacker, Germany. After the patient was checked in and changed into their sleepwear, a technician from the sleep lab attached all the necessary leads to complete the setup. Measurements were taken for airflow, snoring, pulse, blood pressure, SpO2, electromyogram, electrocardiogram, and electrogram. The raw data was collected and assessed at night after the recording ended in the morning [13].

The chief parameters considered in P.S.G. were the number of apneas, hypopneas, and AHI. Total sleep time (T.S.T.) and sleep efficiency. Baseline O_2 Saturation and Minimal SpO_2.

Fibro-optic nasal endoscopy: A fibro-optic nasopharyngoscopy was inserted from a patient's nostril to visualize the upper airway while in supine position by a fibro-optic endoscopy (Machida) connected to a camera (Cymo) with a videorecording system. The patient inhaled forcefully against a closed mouth and nose; thus, this maneuver was essentially the opposite of the Valsalva. Each level was examined both at rest and during the maneuver. At the same time, the patient lay in the supine position, and the results of the degree of collapse and pattern of collapse were recorded and compared.

The levels examined by fibro-optic nasal endoscopy were nasal, retro-palatal, retro-lingual, and hypo-pharyngeal levels. The degree of collapse varied from 25% in mild collapse, 50% in moderate collapse, and 75-100% in severe collapse. The collapse patterns were concentric, coronal, or transverse (sagittal).

Study Procedures:

Fiberoptic nasopharyngoscopy and laryngoscopy were utilized to evaluate the airway. This examination was performed in multiple positions and assessed at different levels, i.e., nasal, retropalatal, retrolingual, and hypopharyngeal (laryngeal) [14]. The effects of gravity and muscular tone are the primary changes between the dynamic architecture of the upper airway during sleep and wakefulness. Theoretically, MM performed in the supine position (MM-P) would reduce the impact of gravity, allowing for a more direct evaluation of muscle tone [15].

Intervention Procedure Technique:

In order to locate the retropalatal, retrolingual, and hypopharyngeal levels of the upper airway, Muller maneuvered a flexible endoscope through the nasal cavity [16]. In order to assess the severity of blockage during nasopharyngoscopy for O.S.A., the Muller maneuver—which involves forcing inspiration through a closed mouth and nose in the opposite direction of Valsalva—was developed [16]. Single- or multi-level upper airway blockages can be considered from a surgical perspective. Nasal, retropalatal, retrolingual, and laryngeal blockage were common levels. Depending on the degree of obstruction, treatment approaches and outcomes may vary [17].

STATISTICAL ANALYSIS

Version 28 of I.B.M.'s Statistical Package for the Social Sciences (SPSS) was used to analyze the data (I.B.M. Corp. Released 2021). (Armonk, NY: I.B.M. Corp., 2018). IBM SPSS Statistics for Windows, Version 28.0. For categorical variables, the absolute frequencies provided the best description. When doing parametric testing, it was necessary to confirm assumptions using the Kolmogorov-Smirnov test. According to the data type, quantitative variables were described using either the median and interquartile range or the means and standard deviations. Data that did not follow a normal distribution was compared using the Mann-Whitney test, while data that did follow a normal distribution was compared using the independent sample t-test. We utilized the Kruskal-Wallis test (for data that does not follow a normal distribution) and the one-way ANOVA test (for data that does follow a normal distribution) to compare quantitative data between the two groups. Tukey's HSD and pairwise comparison were employed to identify significant differences between the two groups. Pearson correlation coefficients (for regularly distributed data) and Spearman rank correlation coefficients (for non-normally distributed data) were utilized to evaluate the degree and direction of correlation between two continuous variables. $P<0.05$ was chosen as the level of statistical significance. If $p\leq0.001$, a highly significant difference was found.

RESULTS

This study included 62 patients aged 28 to 64 (47.26 years). Males represented 61.3% of patients, and about 32% of patients were smokers. B.M.I. ranged from 26 to 50.7 kg/m^2, with a mean of 36.9 kg/m^2 **(Table 1)**.

The apnea-hypopnea index ranged from 5.3 to 110, with a mean of 33.75. The minimum oxygen saturation ranged from 40 to 93%, with a mean of 76.31% **(Table 2)**.

The commonest pattern of retropalatal closure was concentric in 59.7% of patients. In comparison, 66.1% of patients had a lateral obstruction in the retro-laryngeal part, and 61.3% had no closures in the hypopharyngeal part **(Table 3)**.

The mean grades of closure of the retropalatal and retrolaryngeal parts were 76.05% and 67.74%, respectively. The median grade of closure of the hypopharyngeal part was 0% **(Table 4).** Bar chart showing a pattern of closure according to Nasopharyngoscopy: Muller's Maneuver (MM) **(Figure 1).**

Table 1: Demographic data of the studied patients

	N=62	%
Gender **Female** **Male**	 **24** **38**	 **38.7%** **61.3%**
Smoking **No** **Yes**	 **42** **20**	 **67.7%** **32.3%**
	Mean ± SD	**Range**
Age (year)	**47.26 ± 9.16**	**28 – 64**
B.M.I. (kg/m^2)	**36.9 ± 5.88**	**26 – 50.7**

BMI: Body Mass Index

Table 2: Polysomnography results of the studied patients

	Median (IQR)	Range
Apnea hypopnea index	33.75 (12.6–66.2)	5.3 – 110
	Mean ± SD	**Range**
Minimum oxygen saturation	76.31 ± 12.63	40 – 93%

Table 3: Nasopharyngoscopy: Muller's Maneuver (MM) results of the studied patients according to pattern

	N=62	%
Pattern of Retropalatal **Anteroposterior** **Concentric** **Lateral**	 7 37 18	 11.3% 59.7% 29%
Pattern of Retro-laryngeal **Anteroposterior** **Concentric** **Lateral** **No**	 11 9 41 1	 17.7% 14.5% 66.1% 1.6%
Pattern of Hypo-pharyngeal **Anteroposterior** **Lateral** **No**	 6 18 38	 9.7% 29% 61.3%

Table 4: Nasopharyngoscopy: Muller's Maneuver (MM) results of the studied patients according to grade

	N=62	%
Grade of closure	**Median (IQR)**	**Range**
Retropalatal part	**76.05 ± 17.37**	**20 – 100%**
Retro-laryngeal part	**67.74 ± 19.54**	**0 – 100%**
	Median (IQR)	**Range**
Hypo-pharyngeal part	**0(0 – 50)**	**0 – 90%**

I QR: Interquartile Range

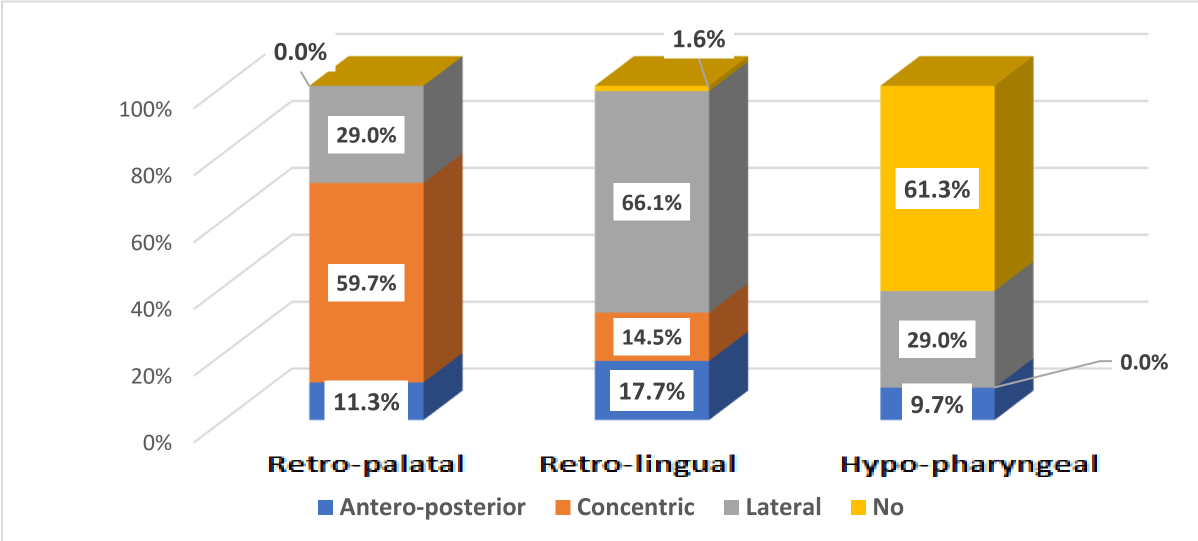

Figure 1: Bar chart showing a pattern of closure according to nasopharyngoscopy: Muller's Maneuver (MM)

DISCUSSION

We conducted the present study to assess the severity and pattern of upper airway collapse in patients with Obstructive sleep apnea. The participants in this study were selected from patients who attended the outpatient clinic of the Zagazig phoniatric unit. Three patients were excluded due to the presence of central or mixed sleep apnea. This study included 62 patients with an age range from 28 to 64 years (mean age: 47.26 years). Males represented 61.3% of patients. About 32% of patients were smokers. B.M.I. ranged from 26 to 50.7 kg/m^2, with mean B.M.I. 36.9 kg/m^2.

The correlation between gender and the apnea-hypopnea index was not statistically significant, nor was it with smoking. The apnea-hypopnea index and body mass index did not correlate significantly.

This agreed with an Egyptian study by Sweed et al. [18], which didn't find any statistically significant difference in O.S.A. severity between both genders. On the other hand, Rezaie et al. [19] mentioned that elevated body mass index indices were thought to be influenced by larger circumferences of the neck and waist. Smoking did not raise the severity of AHI; however, being overweight or obese was a risk factor for severe O.S.A.

A study by Huang et al. [6] discovered that pharyngeal lumen constriction and other abnormalities were seen in obese and non-obese participants, independent of body mass index. It has been suggested that these abnormalities may be due to a genetic predisposition to OSA. These findings suggest that the etiology of OSA is multifactorial.

However, when we narrow our focus to the traditional patient attributes, we risk missing women, the elderly, and individuals with normal weight who have obstructive sleep apnea. It is critical to pay attention to the classic signs of snoring, breathing interruptions, and daytime drowsiness, but evaluation of exercise effectiveness requires subjective metrics. [20].

The apnea-hypopnea index in our study ranged from 5.3 to 110, with a mean of 33.75. The minimum oxygen saturation ranged from 40 to 93%, with a mean of 76.31%. Out of the 62 O.S.A. cases, 41 patients were diagnosed as severe O.S.A., 16 patients were mild O.S.A., and only 5 patients were moderate O.S.A., indicating that the most common grade of severity in our sample size was severe OSA AHI $\geq$ 30.

The results of a retrospective Egyptian study by Gharib and Loza [21] coincided with our study results. Their study concluded that the prevalence of mild, moderate, and severe O.S.A. was 204 (24%), 146 (17%), and 488 (58%), respectively. The most common grade of severity was severe O.S.A.

According to Sweed et al. [18] study: out of 244 cases, Group 1 consisted of patients with mild to moderate OSAS (38% of the total), whereas Group 2 had severe to extremely severe OSAS (62% of the total), suggesting that severe O.S.A. is the most prevalent grade.

Out of 421 patients enrolled in an Egyptian sleep lab over 6 years, 43% were classified as having severe OSAS (AHI > 30). Because patients sought medical advice only after they noticed daytime sleepiness, the authors attributed a late presentation of the disease to a lack of awareness [22].

Our study reported that the most severe grade of closure was found in the retropalatal level, comprising 76.05%, followed by the retrolingual level, 67.74%, and lastly, the hypopharyngeal level.

These findings are similar to those of a previous study by Phua et al. [17], which analyzed O.S.A. patients' upper airway morphology. According to the examination, many patients showed retro-palatal blockage and subsequent collapse of the lateral pharyngeal wall (at the retrolingual level). If these anatomical locations in the upper airway are obstructed, it may indicate severe O.S.A. It is important to target these levels during management if surgery is being considered.

Our findings coincide with those of a former study done by Joy et al. [23] that found out that retro-palatal level was the commonest site collapse followed by retro-lingual level, then epiglottis.

The present study revealed that the most common pattern of retropalatal closure was concentric in 59.7% of the cases, while that of the retrolingual level was lateral obstruction found in 66.1%.

Joy et al. [23] study agreed with our findings as the retro-lingual level has the most prevalent lateral pattern of collapse. On the other hand, the research found that anteroposterior collapse was the most common type of collapse at the retropalatal level.

A study by Yegïn et al. [24] confirmed the present study's findings of a statistically significant agreement in the lateral configuration for diagnosing oropharyngeal-related obstructions.

CONCLUSION

The surgical plan can be identified according to the level, pattern, and grade of airway collapse. The commonest pattern of retropalatal closure was concentric, while retrolaryngeal closure was lateral, and most of the patients did not show collapse at all at the laryngeal level. The grade of closure of retropalatal was the most severe, comprising 76.05%, followed by the retrolingual 67.74%, and the least was the laryngeal level. Muller's Maneuvermaneuver is crucial in identifying the level, pattern, and grade of upper airway obstruction, which serves in the management plan and type of surgery.

Conflict of interest: No

Financial disclosure: No

References

1. Mehrtash M, Bakker JP, Ayas N. Predictors of Continuous Positive Airway Pressure Adherence in Patients with Obstructive Sleep Apnea. Lung. 2019;197(2):115-21.
2. Vardanian M, Ravdin L. Cognitive Complaints and Comorbidities in Obstructive Sleep Apnea. Sleep Med Clin. 2022;17(4):647-56.
3. Chen RF, Nakayama M, Sung WC, Hung JF, Chu YM. Comparison of surgical outcomes of sleep surgeries preoperatively evaluated with drug-induced sleep endoscopy and Müller's Maneuver. Auris Nasus Larynx. 2022;49(2):235-9.
4. Gamaleldin O, Bahgat A, Anwar O, Seif-Elnasr M, Eissa L, Razek AAKA, et al. Role of dynamic sleep M.R.I. in obstructive sleep apnea syndrome. Oral Radiol. 2021;37(3):376-84.
5. Korkmaz M. Ö, Güven M, Elden H, Yılmaz M. S. Comparison of Muller's Maneuver simulated snoring and sleep endoscopy according to VOTE classification in sleep apnea patients. B-ENT,2021, 17(2), 104–9.
6. Huang JF, Chen GP, Wang BY, Xie HS, Zhao JM, Wu LH, et al. Assessment of Upper-Airway Configuration in Obstructive Sleep Apnea Syndrome With Computed Tomography Imaging During Müller Maneuver. Respir Care. 2016;61(12):1651-8.
7. Dempsey JA, Veasey SC, Morgan BJ, O'Donnell CP. Pathophysiology of sleep apnea. Physiol Rev. 2010 Jan;90(1):47–112.
8. Chen H, Aarab G, de Ruiter MH, de Lange J, Lobbezoo F, van der Stelt PF. Three-dimensional imaging of the upper airway anatomy in obstructive sleep apnea: a systematic review. Sleep Med. 2016;21:19-27.
9. Marques M, Genta PR, Azarbarzin A, Sands SA, Taranto-Montemurro L, Messineo L, et al. Retropalatal and retroglossal airway compliance in patients with obstructive sleep apnea. Respir Physiol Neurobiol. 2018;258:98-103.
10. Harly Greenberg, M. T. S. S. W. P. R. S. M. S. Principles and Practice of Sleep Medicine, 2 Volume Set Chapter 131 Obstructive Sleep Apnea Clinical Features, Evaluation, and Principles of Management, 2022.
11. Ito E, Tsuiki S, Maeda K, Okajima I, Inoue Y. Oropharyngeal Crowding Closely Relates to Aggravation of O.S.A. Chest. 2016;150(2):346-52.
12. Chang JL, Goldberg AN, Alt JA, Mohammed A, Ashbrook L, Auckley D, et al. International Consensus Statement on Obstructive Sleep Apnea. Int Forum Allergy Rhinol. 2023;13(7):1061-482.

13. Friedman M. and Jacobowitz O. (Eds.) Clinical polysomnography, 'Sleep Apnea and Snoring E-Book: Surgical and Non-Surgical Therapy—Second Edition, Elsevier Health Sciences, 2018, Chapter 4, p. 23.
14. Aboussouan LS, Golish JA, Wood BG, Mehta AC, Wood DE, Dinner DS. Dynamic pharyngoscopy in predicting outcome of uvulopalatopharyngoplasty for moderate and severe obstructive sleep apnea. Chest. 1995;107(4):946-51.
15. Askar SM, Quriba AS, Hassan EM, Awad AM. Positional Awake Endoscopy Versus DISE in Assessment of O.S.A.: A Comparative Study. Laryngoscope. 2020;130(9):2269-74.
16. Nunes HDSS, Vaz de Castro J, Favier V, Carsuzaa F, Kim M.H.R., Mira FA, et al. Predictors of Success of Pharyngeal Surgery in the Treatment of Obstructive Sleep Apnea: A Narrative Review. J Clin Med. 2023;12(21):6773.
17. Phua CQ, Yeo WX, Su C, Mok PKH. Multi-level obstruction in obstructive sleep apnoea: prevalence, severity, and predictive factors. J Laryngol Otol. 2017;131(11):982-6.
18. Sweed RA, Hassan S, ElWahab NHA, Aref SR, Mahmoud MI. Comorbidities associated with obstructive sleep apnea: a retrospective Egyptian study on 244 patients. Sleep Breath. 2019;23(4):1079-85.
19. Rezaie L, Maazinezhad S, Fogelberg DJ, Khazaie H, Sadeghi-Bahmani D, Brand S. Compared to Individuals with Mild to Moderate Obstructive Sleep Apnea (O.S.A.), Individuals with Severe O.S.A. Had Higher B.M.I. and Respiratory-Disturbance Scores. Life (Basel). 2021;11(5):368.
20. Young T, Skatrud J, Peppard PE. Risk factors for obstructive sleep apnea in adults. JAMA. 2004;291(16):2013-16.
21. Gharib A, Loza S. Factors affecting the severity of the apnea hypopnea index: a retrospective study on 838 Egyptian patients diagnosed with obstructive sleep apnea. EJB, 2020,14(1).
22. Yousif M, El-Helbawy R. A six-year sleep lab experience in an Egyptian University hospital. Egypt J Chest Dis Tuberc, 2013, 62:717–22
23. Joy J, Bhat N, Bhandarkar P. Assessment of Site, Degree, and Pattern of Airway Obstruction in Patients with Moderate to Severe Obstructive Sleep Apnoea (O.S.A.) Using Drug-Induced Sleep Endoscopy (DISE) and Its Association with Awake Fibreoptic Evaluation and Polysomnography Parameters. Indian J Otolaryngol Head Neck Surg. 2021;73(3):315-20.
24. 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(4):445-50.

Citation

Abdellatif, S., Quriba, A., Elshora, A., Hassan, E., Al Nakeb, N. Upper airway collapse during nasopharyngoscopy (Muller’s Maneuver) in Egyptian Adult patients with Obstructive Sleep Apnea. *Zagazig University Medical Journal,* 2024; (4622-4628): -. doi: 10.21608/zumj.2024.322362.3587