International Journal of Otorhinolaryngology and Head and Neck Surgery
Rajanna LB et al. Int J Otorhinolaryngol Head Neck Surg. 2022 Nov;8(11):883-888
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20222677

Original Research Article

Evaluation of degree of upper aerodigestive tract obstruction in patients with snoring and obstructive sleep apnea syndrome

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Received: 02 August 2022
Revised: 22 September 2022
Accepted: 23 September 2022

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ABSTRACT

Background: Objectives of the study were to evaluate the degree of obstruction of upper aerodigestive tract in patients with snoring and obstructive sleep apnea syndrome (OSAS) by nasopharyngolaryngoscopy assisted Muller's maneuver; to evaluate the degree of obstruction of upper aerodigestive tract in patients with snoring and OSAS with imaging technique magnetic resonance imaging (MRI); and to find the association between fibroptic nasopharyngolaryngoscopy assisted Muller's maneuver (NMM) and sleep MRI.
Methods: Study design was open prospective observational study**.** 30 patients diagnosed with snoring and OSA were included in the study at department of ear, nose and throat (ENT), Command Hospital, Air Force, Bangalore. They underwent detailed clinical evaluation and polysomnography followed by assessment of levels and degree of obstruction of upper aerodigestive tract by flexible fiber optic laryngoscopy (FOL) assisted Mullers maneuver and functional (f) sleep MRI.
Results: 20 patients (66.7%) were diagnosed as obstructive sleep apnea syndrome, 10 patients (33.3%) were snorers by Polysomnography. 27 (90%) patients show moderate to severe collapse at level of the base of tongue, 25 (83.3) patients show moderate to severe collapse at the level of soft palate by flexible FOL assisted Mullers maneuver. 22 (73.4%) patients show a collapse the level of the soft palate, 20 (66.6%) patients show a collapse at the level of the base of tongue by f sleep MRI. In this study, on applying Chi square test there was significant association between soft palate Flexible nasopharyngoscopy with muller's method and soft palate MRI with Chi square value 35.690, p value <0.001. There was significant association between base of tongue flexible nasopharyngoscopy with Muller's method and base of tongue sleep MRI with Chi-square value 14.511, and p value <0.005.
Conclusions: Polysomnography is gold standard test to diagnose OSA. Flexible nasopharyngoscopy with Muller's method and sleep MRI shows the most common site of upper airway collapse is at the level of the soft palate and the base of tongue.

Keywords: Obstructive sleep apnea, Polysomnography, Flexible nasopharyngoscopy, Mullers method, Sleep MRI

INTRODUCTION

In recent years, snoring and obstructive sleep apnea syndrome (OSAS) has emerged as an important public health problem. Sleep related breathing disorders are known to cause sleep deprivation, resulting in daytime drowsiness and lack of concentration. It also causes significant psychological and social damage to the sufferers. In the early 1980s it was clear that OSAS was a common condition affecting both gender with male predilection. The first landmark epidemiologic study by Young in 1993 showed that prevalence of OSAS was 3% and 7% of middle-aged women and men respectively.[1] Snoring is the most common result of the changes in the properties of the upper airway that occur during sleep. Snoring is characterised by the production of sound as a result of vibrations of the soft tissues of pharynx, soft palate and uvula having specific acoustic characteristics.[2] Initially Lugaresi in his study with radiographic recordings showed that increased oesophageal pressure during inspiration which causes partial pharyngeal obstruction.[3] There has been an increased recognition and interest started on syndrome of sleep disordered breathing from 1960. Walsh in 1972 studied the upper airway during sleep using cine fluoroscopy and stated that tongue retracting into apposition with the posterior pharyngeal wall was the reason for upper airway obstruction in patients with OSA.[4] Airway shape and size are critical to the air flow. Nasal obstruction has an effect in severity of OSA. Nasal obstruction increases the tendency for breathing through the mouth which subsequently destabilizes the lower pharyngeal airway by displacement of the hyoid. Tongue falls posteriorly in the supine position and counteracted by the tone of the genioglossal muscle. Volumetric studies have shown that tongue size is important factor which resulting in collapse and difficulties in reopening the airways and contributes as a major predictor of OSA.[5] The tongue is larger and the soft palate is both longer and wider in OSA patients compared to healthy individuals. Evaluation of the upper airway has indubitably contributed to the understanding of the pathophysiology of snoring and OSAS. It additionally helps us to identify the subjects with increased risk as well as to select an appropriate modality of treatment, especially for surgical procedures.

Today there are many subjective and objective test available to diagnose and assess the severity of sleep related breathing disorders. Epworth scale named after its origin at Epworth hospital, Victoria, Australia is the commonest subjective questionnaire used in assessment.[6] This questionnaire assesses on a numerical scale the likelihood of the patient falling asleep in a given set of real-life situations. Polysomnography is the gold standard for diagnosing OSAS. Flexible fiber optic nasopharyngolaryngoscopy with Muller’s maneuver, an outpatient procedure, is used to detect the collapse of upper airway in awake state.[7] This procedure helps in recording decrease in cross sectional area and to correlate it with the severity of the disorder. Sleep magnetic resonance imaging (MRI) is an investigation which gaining popularity because of its precise localization of obstruction in OSAS which were unidentifiable earlier by other modalities.[8] MRI and computer-based analysis techniques allows objective quantification of the tongue, soft palate, parapharyngeal fat pads, and lateral pharyngeal walls.

While each of these tools in the diagnostic armamentarium has its own specific advantages, the search for the ideal is still on. An ideal diagnostic modality for sleep related breathing disorders must be economical, easy to perform, reliable and consistent in results. This study addresses this issue by evaluating the currently available modalities. It aims at studying the morphology of upper aero digestive tract in subjects with snoring and OSAS, evaluated by flexible fiber optic nasopharyngoscopy and magnetic resonance imaging discussing their relative merits and demerits. It is reasonable to presume that the data generated about the anatomical risk factors contributing to snoring and obstructive sleep apnea syndrome will be clinically and therapeutically valuable.

METHODS

Source of data

The study includes patients (n=30) diagnosed as snoring and OSAS at department of ENT, Command Hospital, Air Force, Bangalore.

Inclusion criteria

Patients with age >16 years, diagnosed with snoring and OSAS were included in the study.

Exclusion criteria

Patients with history of any congenital structural anomalies, who have undergone previous nasal and oropharyngeal surgery, diagnosed upper aerodigestive malignancies, pregnant, with chronic intake of sedative medications, and with a metallic object in the body or other contraindication to MRI were excluded from the study.

Evaluation and assessment

After fulfilling inclusion and exclusion criteria, patients were recruited to study protocol. On completion of history and clinical evaluation patients were subjected to following tests.

Polysomnography

This test done with Philips 7 channel type of sleep study and recordings were analysed by sleep analyst and final opinion given by respiratory physician.

Flexible fiberoptic nasopharyngolaryngoscopy assisted Muller’s maneuvre

Patients were evaluated with flexible fiberoptic nasopharyngolaryngoscopy with Muller’s maneuver video captured using carl storz image capturing device and it has been recorded digitally into hard disk of laptop. These videos are recorded by trained professional and evaluated by trained senior ENT specialist who was blind to the clinical and radiological details of the patient. This procedure carried out as single blinded test and all participants were allotted with unique identity number and all documents were considered confidential and kept in safe locker.

Degree of severity of obstruction were assessed for 4 levels of upper airway- nasopharynx, soft palate, base of tongue and epiglottis and were reported on a numerical scale as follows.

Degree of obstruction: 1-minimal collapse <25%, 2-collapse decrease in cross sectional area by >25 to <50%, 3-collapse decrease in cross sectional area by >50 to < 75%, and 4-obliteration of the airway >75%.

This above numerical grades are further divided into three categories: mild- airway collapse <25%, moderate-collapse decreasing cross sectional area by >25 to <50%, and severe- collapse decreasing cross sectional area by >50 to complete obliteration.

Sleep MRI

MRI images were obtained using an MRI system (Siemens 1.5T; MRI Systems, Japan). These images are recorded by trained professional and evaluated by trained radiology specialist who was blind to the clinical and radiological details of the patient. This procedure carried out as single blinded test and all participants were allotted with unique identity number and all documents were considered confidential and kept in safe locker. Degree of severity of obstruction were assessed for 4 levels of upper airway and were reported as similar to endoscopic test.

RESULTS

Total study population included 30 patients. Out of 30 patients' males were 22 (73.3%), females were 08 (22.7%) represented in Figure 1. 20 (66.7%) patients were diagnosed as obstructive sleep apnea syndrome, 10 (33.3%) patients were snorers represented in Figure 2. Polysomnography results showed mild 10%, moderate 43.3%, severe 13.3%, remaining 33.3% normal represented in Figure 3. 27 (90%) patients show moderate to severe collapse at level of the base of tongue, 25 (83.3) patients show moderate to severe collapse at the level of soft palate (Table 1). 22 (73.4%) patients show a collapse the level of the soft palate, 20 (66.6%) patients show a collapse at the level of the base of tongue (Table 2). In this study, on applying Chi square test there was significant association between soft palate flexible nasopharyngoscopy with muller's method and soft palate MRI with Chi square value 35.690, df=6, p value <0.001 (Table 3). There was significant association between base of tongue flexible nasopharyngoscopy with Muller's method and base of tongue sleep MRI with Chi square value 14.511, df=4 and p value <0.005 (Table 4).

Statistical analysis

Descriptive and statistical analysis done. Chi square test is used.

$$x^2 = (Oi - Ei)^2/Ei$$

Where Oi is the observed frequency and Ei is expected frequency, with (n-1) df.

Table 1: Distribution of patients according to their endoscopic results (n=30).

NMM	No.	Percentage
Nasopharynx		
Mild	27	90.0
Moderate	3	10.0
Soft palate		
Mild	5	16.7
Moderate	16	53.3
Severe	9	30.0
Base of tongue		
Mild	3	10.0
Moderate	18	60.0
Severe	9	30.0
Epiglottis		
Mild	30	100.0

Table 2: Distribution of patients according to their sleep MRI results (N=30).

Sleep MRI	No.	Percentage
Nasopharynx		
Mild	30	100.0
Soft palate		
Mild	8	26.7
Moderate	14	46.7
Severe	8	26.7
Base of tongue		
Mild	10	33.3
Moderate	13	43.3
Severe	7	23.3
Epiglottis		
Mild	30	100.0

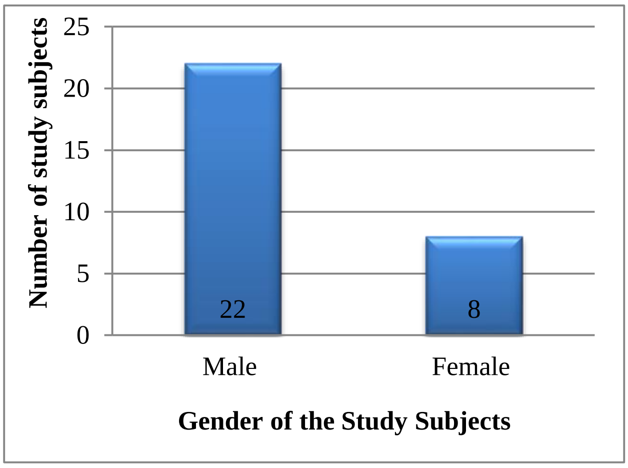

Figure 1: Distribution of patients according to their gender (N=30).

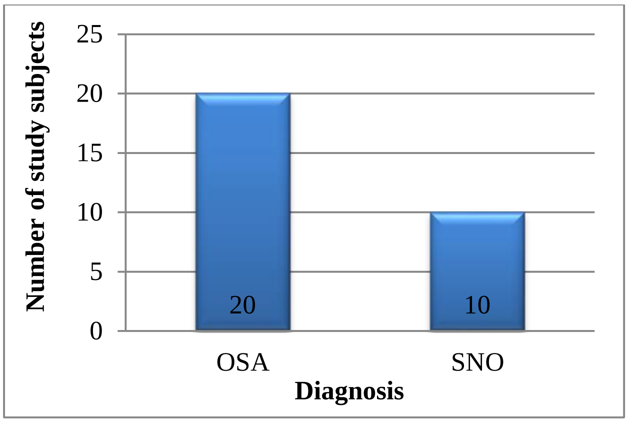

Figure 2: Distribution of patients according to the diagnosis (n=30).

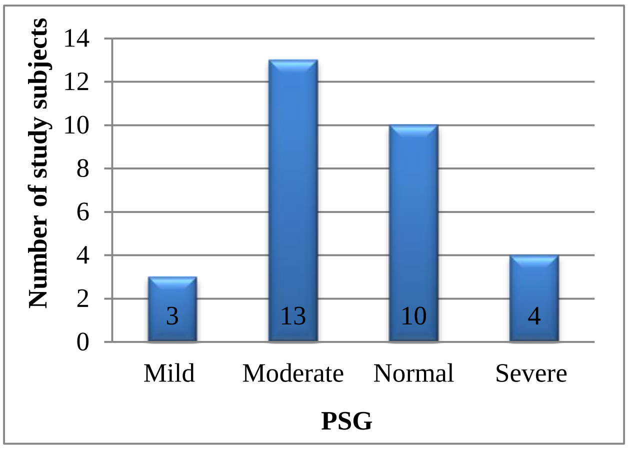

Figure 3: Distribution of patients according to the PSG (n=30).

Table 3: Association between soft palate flexible nasopharyngoscopy with Muller's method and soft palate MRI.

Soft palate level (NMM)	Sleep MRI			Total
	Mild	Moderate	Severe	
Mild	5	0	0	5
Moderate	3	12	1	16
Severe	0	2	7	9
Total	8	14	8	30

Table 4: Association between base of tongue flexible nasopharyngoscopy with Muller's method and base of tongue sleep MRI.

Base of tongue level (NMM)	Sleep MRI			Total
	Mild	Moderate	Severe	
Mild	3	0	0	3
Moderate	7	9	2	18
Severe	0	4	5	9
Total	10	13	7	30

Statistical software

Data was entered into Microsoft excel (Windows 7; version 2007) and analyses were done using the statistical package for social sciences (SPSS) for Windows software (version 18.0; SPSS Inc, Chicago).

DISCUSSION

Snoring is a most common presenting symptom in obstructive sleep apnea syndrome. In the recent years, Snoring and Obstructive sleep apnea syndrome has emerged as an important public health problem. Snoring is characterized by the vibration of respiratory structures and the loud sound, due to air movement through narrowed passage during sleep. The mechanism of snoring has been related to increase upper airway collapsibility and change in upper airway size, alterations in surrounding soft tissue structures includes tonsils, pharyngeal wall and craniofacial structures. Snoring and OSAS also cause sleep deprivation, daytime drowsiness, lack of concentration and significant psychological and social problems. Total number of patients in this study was 30. Age of patients varied from 20 to 69 years. Mean age of the study population was 49 years. Maximum patients were in the age group 51 to 60 years forming about 40% of the study group. Oliven et al stated that airway collapse increases as individual grows older.[9] Males (73.3%) outnumbered the females (26.7%) in the current study. This result is in accordance with indexed literature where males outnumbered the females like that of Trinder.[10]

Polysomnography

Overnight polysomnography in a sleep laboratory is the "gold standard" method for diagnosing OSAS.[11] Study group underwent type 2 seven channel polysomnography which was analysed by sleep analyst and final opinion by pulmonologist. Type 2 PSG study includes a technician goes to the patient's house and wires the patient up and conduct the study. Sleep study is essential to know the physiological or pathological changes during sleep.[12] Severity of OSA classified using AHI.[13]

Normal: AHI <5, mild OSA: AHI 5 ≤15, moderate OSA: AHI 15 ≤30, severe OSA: AHI >30 events per hour of sleep. In our study polysomnography results among study group were mild 10%, moderate 43.3%, severe 13.3%, remaining 33.3% normal.

Flexible nasopharyngoscopy with Muller's method

The nasopharyngofibroscopy assisted Muller's manoeuvre (NMM), first described in 1983 by Borowiecki. A flexible nasopharyngoscope was passed through the anesthetized nasal cavity to visualize upper airway. Then collapse of the upper airway is assessed by asking patient take a deep breath in with an open glottis against closed mouth and nose.[14] The nasopharyngoscope was withdrawn from the upper level of epiglottis to nasopharynx to record the collapse of upper airway. The estimated degree of airway collapse was described qualitatively as a percentage change in cross-sectional airway area and divided into quartile groups of <25%, 25% to 50%, 50% to 75%, and >75% at each level. In our study flexible nasopharyngoscopy with Muller's method results shows 27 (90%) patients has moderate to severe collapse at level of the base of tongue, 25 (83.3) patients have moderate to severe collapse at the level of soft palate. These results supported The Muller test allows an examiner to demonstrate the sites of pharyngeal narrowing, especially in the retro palatal area, retro lingual area of the oropharynx and the hypopharynx. Nasopharyngoscopy with Muller's method allows to direct visualization of pharynx and by increasing negative intraluminal pressure also helps in dynamic changes of pharynx seen in OSA.[15]

Sleep MRI

Gold standard alternative method to examine dynamic upper airway during sleep is sleep MRI.[16] Sleep MRI studies are noninvasive and allow dynamic abnormalities of the entire airway to be assessed at once. This novel diagnostic imaging modality sleep MRI allows us to identify the narrowing sites of the upper airway. In our study, 22 (73.4%) patients show a collapse the level of the soft palate, 20 (66.6%) patients show a collapse at the level of the base of tongue. Ikeda et al observed that significant obstruction and narrowing of various sites of the pharyngeal airway in the OSAS patients, but not in the non-OSAS subjects measured by dynamic MRI. Another study shows decrease in the antero-posterior diameter and cross-sectional area at retro-palatal and retro glossal levels of the upper airway in cases in comparison with controls.[17]

Strengths of the study

This study, being of descriptive nature, dealt mainly with clinical features that OSAS patients presents with snoring, excessive daytime sleepiness and study group undergo series of investigation which includes polysomnography, flexible nasopharyngoscopy with Muller's method and sleep MRI.

Limitations

There is no standard method defined to measure the degree of obstruction of upper airway in snoring and OSA. Study group consisted only limited number (30) of patients.

CONCLUSION

Polysomnography is a gold standard test to diagnose OSA and was done in all study group to categorize into OSA and non OSA as a snorer. Flexible nasopharyngofibroscopy with Muller's method; a simple, minimally invasive OPD procedure, was carried out under local anaesthesia and was well tolerated by the patients. There is no gold standard method to precisely locate the obstruction site of the upper airway during sleep in patients with OSA but gold standard alternative is sleep MRI which non-invasive method to localize the accurate obstruction sites, which was carried out in all patients. Various measures were undertaken during the course of the study to avoid any kind of bias. Endoscopy was performed in all patients by a single independent ENT specialist who was blinded to patient clinical and radiological information. Same way sleep MRI was carried by a single independent radiologist who was blinded to patients clinical and endoscopic information.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Lohith BR, Muniraju B, Kumar S, Reddy NM, Malleshappa V. Evaluation of degree of upper aerodigestive tract obstruction in patients with snoring and obstructive sleep apnea syndrome. Int J Otorhinolaryngol Head Neck Surg 2022;8:883-8.