THE IMPORTANCE OF NASOENDOSCOPIC FINDINGS & MULLER'S MANEUVER IN PREDICTING SEVERITY OF OBSTRUCTIVE SLEEP APNOEA

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KEPENTINGAN PEMERIKSAAN HIDUNG DAN UJIAN GERAKAN MULLER MENGGUNAKAN SKOP DALAM MENENTUKAN TAHAP KETERUKAN HALANGAN TIDUR APNEA

ABSTRAK

Objektif: Untuk menentukan perkaitan di antara lengkungan septum hidung (DNS), turbinat bawah hipertrofi (ITH) dan halangan saluran pernafasan atasan semasa gerakan Muller (MM) dengan keterukan halangan tidur apnea (OSA)

Kaedah: Kajian rentas lintang melibatkan pesakit dengan OSA. Semua pesakit yang memenuhi kriteria dan telah memberi persetujuan untuk penglibatan di dalam ujian ini, menjalani pemeriksaan hidung menggunakan 0-darjah skop tegar menumpukan kepada struktur turbinate bawah dan septum hidung, pemeriksaan saluran pernafasan atasan juga dilakukan dengan menggunakan endonasopharingolaringoskop fleksibel (FNPLS) untuk MM. Klasifikasi Mladina bagi DNS telah digunakan. Sosiodemografi data dan ciri klinikal bagi turbinat bawah, septum hidung dan halangan salur pernafasan atasan direkodkan dan dianalisa menggunakan pakej statistik untuk sains sosial (SPSS).

Keputusan: Sebanyak 64 pesakit berumur di antara 23 hingga 60 tahun (31 lelaki dan 33 wanita) telah terlibat. Umur purata adalah 40.8 ± 8.8 tahun dan purata indeks jisim tubuh (BMI) adalah 29.7 ± SD 2.9. Perkaitan antara DNS dan keterukan OSA, juga antara penemuan semasa MM dengan keterukan OSA secara statistiknya adalah berkaitan dengan nilai -p <0.001. Walaubagaimanapun, ITH tidak menunjukkan perkaitan dengan keterukan OSA dengan nilai-p > 0.05

Kesimpulan: Secara keseluruhan, lengkungan septum hidung mengikut klasifikasi Mladina dan halangan salur pernafasan atasan mempengaruhi tahap keterukan OSA.

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ABSTRACT

Objectives*:* To determine the association between deviated nasal septum (DNS), inferior turbinate hypertrophy (ITH) and upper airway obstruction during Muller's maneuver (MM) with severity of obstructive sleep apnoea (OSA).

Methods: A cross sectional study involving patients with OSA. All consented patients who fulfilled the criteria underwent upper airway examination using rigid 0-degree endoscope and flexible nasopharyngolaryngoscope (FNPLS) for MM, focusing on the anatomy of inferior turbinate and nasal septum as well as the airway obstruction at retropalatal and retroglossal levels. Mladina classification of DNS was used. Sociodemographic data and clinical characteristic for inferior turbinate, nasal septum and upper airway obstruction were recorded and analyzed using Statistical Package for Social Sciences (SPSS).

Results: A total of 64 OSA patients aged between 23 to 60 years (31 male and 33 female) involved. The average age was 40.8 ± 8.8 years and the mean BMI was 29.7 ± sd 2.9. The association between DNS and severity of OSA, also between MM findings with severity of OSA were highly significant with p-value <0.001. However, ITH did not show a significant association with severity of OSA (p-value >0.05).

Conclusion: Overall, DNS based on Mladina classification and upper airway obstruction during MM are significant in predicting severity of OSA.

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In Loving Memory

TUAN HAJI MOHAMED BIN HUSSIN
(1941-2016)

CHAPTER 1:

INTRODUCTION

1.1 INTRODUCTION

Obstructive sleep apnoea/hyponoea is a respiratory sleep disorder characterized by recurrent episodes of partial or complete upper airway obstruction, resulting in intermittent cessation of breathing (apnoea) and reduction in airflow (hypopnoea). Obstructive sleep apnoea is also categorized as part of the spectrum in the sleep-related sleep disorder that ranges from upper airway resistance syndrome to obesity-hypoventilation syndrome (Pickwickian syndrome) (1). This condition is under recognized despite its common presentation in the society. Men have higher risk to have OSA than women (1,2). In the United States, OSA affects 24% men and 9% in women (2). The prevalence of OSA among the major ethnic group in Malaysia was found to be 30%, 19.7% and 12% in Malay, Chinese and Indian respectively (3). It is crucial to make a diagnosis as its complications can be serious, affecting patients' psychology, medical well-being and occupation. The symptoms of OSA include snoring, excessive daytime sleepiness or fatigue and witnessed apnoea (4). When OSA is clinically likely, a polysomnography (PSG) needs to be done as this remains as the gold standard for diagnosing OSA (4,5).

1.2 RISKS FACTOR OF OBSTRUCTIVE SLEEP APNOEA

The risk factors of OSA and snoring include age 40-65, male sex, obesity, smoking, alcoholism and sedentary lifestyle (1).

1.2.1 AGEING

Several studies have shown a higher prevalence of OSA in older population. OSA can happen in any age group but it typically happens between age of 40-60 years old (2). It has been reported that OSA is present in about 6% of the population between age 50-70 years old

(6). This is due to the anatomical changes of the larynx as people age which causing it to have a higher collapsibility (6). Besides, aging causes a decrease in negative pressure reflex, increased deposition of parapharyngeal fat, lengthening of the soft palate and changes in the bony shape surrounding he pharynx. These changes contribute to pharyngeal collapse (5,6)

1.2.2 GENDER

OSA occurs more predominantly in males, in which men are twice likely to develop OSA with an estimated prevalence of 4% compare to women which is only 2% (2).

1.2.3 OBESITY

This is the most important risk factor for OSA since majority if OSA patients are obese (2). There is a relationship between body weight and AHI score on PSG. According to a study by Young et al., an increment of weight by 10% will increase AHI up to 32% and weight decrement by 10% will decrease AHI up to 26% (2). Obesity is associated with increased circumferential fat tissue around neck (4). This leads to narrowing of the airway.

1.3 PHYSICAL EXAMINATION & INVESTIGATIONS

When OSA is suspected, a thorough clinical examination will be carried out and this includes an examination of the airway, mainly to look for any obstruction. The main physical examination findings associated with OSA are increased neck circumference, oropharyngeal obstruction, web palate, nasal obstruction, turbinate hypertrophy, septal deformity, nasal tumour, enlarged tonsils, macroglossia and retroglossia (1). The examination that usually done at ORL clinic are endoscopy of the upper airway and Muller's maneuver (MM).

Table 1.1 Common physical findings in OSA patient

Craniofacial	**Retrognatia**
	High arched palate
	Temporomandibular dislocation
Pharynx	Macroglossia
	Erythema/oedema of uvula
	Elongated, low-lying soft palate
	Tonsillar pillar hypertrophy
	Tonsillar enlargement
	Retropalatal, retroglossal space restriction
Dental	Overjet
	Malocclusion
	Bruxism
	Orthodontia
Nasal cavity	Asymmetric, small nares
	Septal deviation
	Inferior turbinate hypertrophy

Adapted from Bhattacharyya and Friedman (2009)

1.3.1 NASOENDSOCOPIC EXAMINATION

Nasal examination is important in evaluating the airway for any possible obstruction. Inspection of the nose will give information regarding the size and symmetry of nares, collapsibility of the valves and septal deviation. An examination with rigid 0-degree scope will have a better visualisation of the nasal cavity. Any obstruction ie: due to septal deviation,

inferior turbinate hypertrophy or nasal mass can be assessed properly. This examination can be done at clinic while patient is awake and sitting upright.

1.3.2 MULLER'S MANEUVER

The Muller's maneuver (MM) is first introduced in 1983 by Borowieki and Sassin, which involves using a flexible endoscope through the nasal cavity to identify the retropalatal level of the upper airway (1,7). Snoring and apnoea can be simulated by MM during wakefulness and it has been used in upper airway evaluation before surgical intervention in patients to predict surgical outcome and to improve patient selection (8). The MM is safe and easy to perform on patient in siting position during nasoendoscopic examination. The maneuver requires patient to perform a forced inspiration with closed nose &mouth. The airway obstruction at retropalatal and retroglossal level can be seen using nasoendoscope.

1.3.3 POLYSOMNOGRAPHY

Polysomnogram is the gold standard to diagnose OSA (4,5). It is usually done overnight in a sleep lab in which multiple variables are recorded while patient asleep. Such parameters include:

1. Electroencephalography
2. Electrocardiography
3. Electrooculography
4. Electromyography
5. Oxygen saturation
6. Chest and abdominal walls monitor
7. Postural muscle tone
8. Sleep position
9. Snore detector

This study will determine the severity of OSA based on apnoea-hypopnoea index (AHI). The AHI is the average number of apnoea and hypopnoea per hour sleep and the severity of OSA based on PSG is shown below.

Table 1.2 Severity of OSA in adult

Severity	*Sleepiness*	*AHI*
Mild	Unwanted sleepiness or involuntary sleep episodes during activity requiring little attention like watching television, reading	5-15
Moderate	Unwanted sleepiness or involuntary sleep episodes during activity requiring some attention like meeting, attending a performance	15-30
Severe	Unwanted sleepiness or involuntary sleep episodes during activity requiring active attention like driving, operating a machine	>30

CHAPTER 2:

OBJECTIVES OF THE STUDY

OBJECTIVES OF STUDY

2.1 General objective

To determine the importance of nasoendoscopic findings and Muller's maneuver in predicting obstructive sleep apnoea.

2.2 Specific objectives

1. To determine the association of DNS and ITH with severity of OSA.
2. To determine the association between findings on Muller's maneuver and severity of OSA
3. To identify the types of DNS based on Mladina classification, inferior turbinate hypertrophy and findings on Muller's maneuver in OSA patients

CHAPTER 3:

MANUSCRIPT

3.1 TITLE

THE IMPORTANCE OF NASOENDOSCOPIC FINDINGS AND MULLER'S MANEUVER IN PREDICTING SEVERITY OF OBSTRUCTIVE SLEEP APNOEA

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None

3.2 ABSTRACT

Introduction: Obstructive sleep apnoea/hyponoea (OSA) is a respiratory sleep disorder characterized by recurrent episodes of partial or complete upper airway obstruction, resulting in intermittent cessation of breathing (apnoea) and reduction in airflow (hypopnoea). It is crucial to make a diagnosis of this under recognized disorder as its complications can be debilitating. We studied the importance of nasoendoscopic findings and Muller's Maneuver (MM) in predicting severity of OSA.

Objectives: To determine the association between deviated nasal septum (DNS), inferior turbinate hypertrophy (ITH) and upper airway obstruction during Muller's maneuver (MM) with severity of obstructive sleep apnoea (OSA).

Methods: A cross sectional study involving patients with OSA. All consented patients who fulfilled the criteria underwent upper airway examination using rigid 0-degree endoscope and flexible nasopharyngolaryngoscope (FNPLS) for MM, focusing on the anatomy of inferior turbinate and nasal septum as well as the airway obstruction at retropalatal and retroglossal levels. Mladina classification of DNS was used. Sociodemographic data and clinical characteristic for inferior turbinate, nasal septum and upper airway obstruction were recorded and analysed using Statistical Package for Social Sciences (SPSS).

***Results*:** A total of 64 OSA patients aged between 23 to 60 years (31 male and 33 female) involved. The average age was 40.8 ± 8.8 years and the mean BMI was 29.7 ± sd 2.9. The association between DNS and severity of OSA, also between MM findings with severity of OSA were highly significant with p-value <0.001. However, ITH did not show a significant association with severity of OSA (p- value >0.05).

***Conclusion*:** Overall, DNS based on Mladina classification and upper airway obstruction during MM are significant in predicting severity of OSA.

Keywords: obstructive sleep apnoea, deviated nasal septum, inferior turbinate hypertrophy, Muller's maneuver, Mladina classification.

3.3 INTRODUCTION

Obstructive sleep apnoea/hyponoea is a respiratory sleep disorder characterized by recurrent episodes of partial or complete upper airway obstruction, resulting in intermittent cessation of breathing (apnoea) and reduction in airflow (hypopnoea). Obstructive sleep apnoea (OSA) is also categorized as part of the spectrum in the sleep-related sleep disorder that ranges from upper airway resistance syndrome to obesity-hypoventilation syndrome (Pickwickian syndrome) (1). This condition is under recognized despite its common presentation in the society. The risk factors of OSA and snoring include age 40-65, male sex, obesity, smoking, alcoholism and sedentary lifestyle (1, 2). In the United States, OSA affects 24% men and 9% in women (2). The prevalence of OSA among the major ethnic group in Malaysia was found to be 30%, 19.7% and 12% in Malay, Chinese and Indian respectively (3).

It is crucial to make a diagnosis as its complications can be serious, affecting patients' psychology, medical well-being and occupation. The symptoms of OSA include snoring, excessive daytime sleepiness or fatigue and witnessed apnoea (1-3). When OSA is suspected, a thorough clinical examination will be carried out and this includes an examination of the airway, mainly to look for any obstruction. The main physical examination findings associated with OSA are increased neck circumference, oropharyngeal obstruction, web palate, nasal obstruction, turbinate hypertrophy, septal deformity, nasal tumour, enlarged tonsils, macroglossia and retroglossia (1, 4). The gold standard for diagnosing OSA is polysomnography (PSG) (4, 5).

A study by Joseph et al. concluded that the enlargement of the oropharyngeal soft tissue structures particularly the lateral pharyngeal wall, such as tonsillar hypertrophy, is associated with an increased likelihood of OSA (6). On the other hand, Rodrigues et al. has found that deviated nasal septum (DNS) and inferior turbinate hypertrophy (ITH) were significantly

correlated with the severity of OSA with p-value of 0.03 & 0.05 respectively (1). These nasal anatomical variants are more important than nasal airway volume when evaluating OSA patients (1).

With regard to Muller's maneuver (MM), even though it has been used as a tool for airway assessment, a systemic review of journals by Soares et al., has found that there are controversies whether MM can predict the location of upper airway obstruction and severity of the disease (7). Similar conclusion was made by Ozcan et al, that MM does not provide useful data to predict REM dependency of OSAS (8).

This study aimed to determine the importance of nasoendoscopic findings and MM in predicting the severity of OSA, specifically looking at the respective association between DNS, ITH and airway obstruction with severity of OSA.

3.4 METHODOLOGY

We conducted a cross sectional study aiming to find the association of MM and nasoendoscopic findings with severity of OSA. This study was approved by the Human Research Ethic Committee, Universiti Sains Malaysia with code number USM/JEPeM/18120808. A retrospective data review of OSA patients from ORL sleep clinic Hospital Universiti Sains Malaysia were done from June 2018 to June 2019. Sample size was determined using the sample size calculator (two proportion formula) developed by the Biostatistics and Research Methodology Unit, School of Medical Sciences USM. The sample size calcution was based on studies by Rodrigues et al. (1) and Oguzhan et al. (9). The early selection for data review was made by simple random sampling method using Research Randomizer (version 4.0) developed by Urbaniak G.C & Plous S. The important data such as age, BMI, polysomnography result and history of upper airway surgery were reviewed.

The inclusion criteria were adult OSA patients aged 20-64 with a valid PSG report, and had not yet undergone any OSA interventions. The exclusion criteria were elderly patient, bilateral tonsillar hypertrophy, nasal polyp/tumour, adenoid hypertrophy, craniofacial abnormalities, previous surgery pertaining to OSA correction.

Sixty-four consented patients who fulfilled the criteria underwent upper airway examination using rigid 0-degree endoscope and flexible endoscope for MM, paying attention to the anatomy of inferior turbinate and nasal septum as well as airway obstruction at retropalatal and retroglossal level. The severity of OSA was categorized according to apnoea-hypopnoea index (AHI): no OSA with AHI <5 events/hour, mild OSA: AHI 5 to <15, moderate: AHI 15 to <30 and severe: AHI 30 and above. The degree of upper airway obstruction at retropalatal and retroglossal areas were recorded as; grade 1: no obstruction, grade 2: up to 50% obstruction, grade 3: more than 50% but less than 100%, grade 4: complete obstruction. For ITH, no hypertrophy was recorded as normal, mild hypertrophy when the size did not cross the midline nostril, moderate hypertrophy when the size crossed midline nostril and severe hypertrophy when it touched the septum. For DNS, Mladina classification was used:

Type I: unilateral vertical crest at nasal valve

Type II: same as type 1 but affecting nasal valve function

Type III: unilateral vertical crest at the level of middle turbinate

Type IV: combination of type 2 and 3

Type V: unilateral ridge at the base of septum, contralateral septum is straight.

Type VI: unilateral ridge at the base of septum, with septal sulcus on contralateral septum

Type VII: combination of type I-VII

(Type 0 was used to denote normal nasal septum in this study)

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS version 24.0, IBM corporation). Descriptive statistic and Pearson chi square test were used to determine the association between related variables with severity of OSA. A p-value <0.05 was considered statistically significant association.

3.5 RESULTS

This study involved 64 OSA patients determined by polysomnography and they were evaluated between June 2018 and June 2019. Among study population, 21 (32.8%) suffered from mild OSA, 27 (42.2%) with moderate OSA and 16 (25.0%) with severe OSA (figure 1). Table 1 and figure 2 summarized the sociodemographic characteristics of the patients. There were 31(48.4%) males and 33 (51.6%) females included in the study. The results showed female tends to suffer from mild and moderate OSA whereas male has higher number than female, to suffer from severe OSA. The study population were predominantly Malay (84.4%) followed by Chinese (9.4%) and Indian (6.2%). The mean age was 40.8 (± 8.8) years and the mean BMI was 29.7 (± 2.9). Figure 2 showed the age distribution of study population according to severity of OSA. The median age for mild OSA group was in the 3rd decade (37.0 ± 8.9 years) and the median age for both moderate and severe OSA groups was in the 4th decade (44.0 ± 8.5 years ; 40.3 ± 7.6 years).

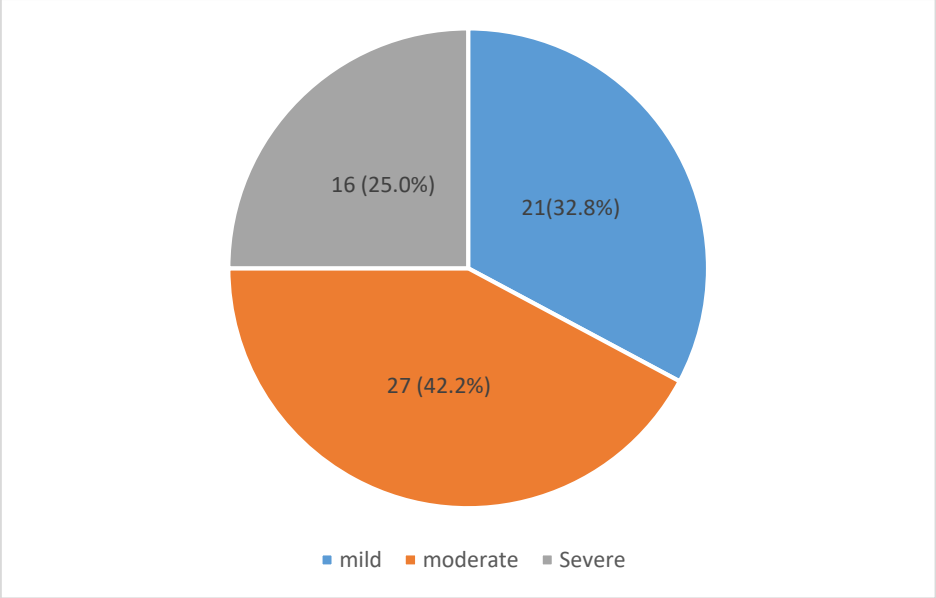

Figure 1: Severity of OSA among study population (n=64)

Table 1: Sociodemographic characteristics of OSA patients.

	Severity of OSA			Total
	Mild n = (%)	Moderate n = (%)	Severe n = (%)	n = (%)
Gender				
Male	9 (42.9)	12 (44.4)	10 (62.5)	31 (48.4)
Female	12 (57.1)	15 (55.6)	6 (37.5)	33 (51.6))
Ethnicity				
Malay	19 (90.4)	22 (81.5)	13 (81.3)	54 (84.4)
Chinese	1 (4.8)	4 (14.8)	1 (6.3)	6 (9.4)
Indian	1 (4.8)	1 (3.7)	2 (18.8)	4 (6.2)

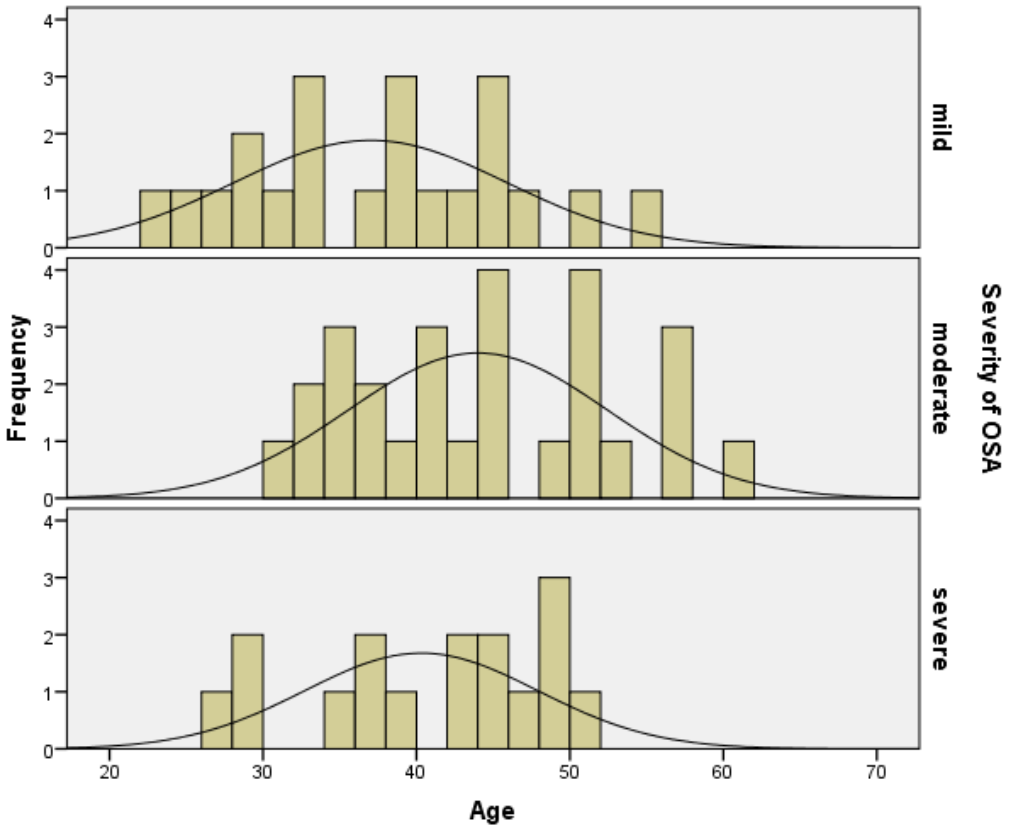

Figure 2: Age distribution among OSA patients

Table 2: Clinical characteristics of OSA patients

Variables	Severity of OSA			Total	P- value[a]
	Mild n = (%)	Moderate n = (%)	Severe n = (%)	**n = (%)**	
MM					
Retropalatal					
1	2 (9.5)	0 (0.0)	0 (0.0)	2 (3.1)	
2	11 (52.4)	9 (33.3)	0 (0.0)	20 (31.3)	<0.001
3	6 (28.6)	18 (66.6)	9 (56.3)	33 (51.6)	
4	2 (9.5)	0 (0.0)	7 (43.7)	9 (14.0)	
Retrolingual					
1	5 (23.8)	0 (0.0)	0 (0.0)	5 (7.8)	
2	13 (61.9)	16 (59.3)	1 (6.3)	30 (46.9)	<0.001
3	3 (14.3)	11 (40.7)	14 (87.4)	28 (43.7)	
4	0 (0.0)	0 (0.0)	1 (6.3)	1 (1.6)	
ITH					
normal	1 (4.8)	0 (0.0)	0 (0.0)	1 (1.6)	
mild	5 (23.8)	8 (29.6)	2 (12.5)	15 (23.4)	0.155
moderate	15 (71.4)	19 (70.4)	12 (75.0)	46 (71.9)	

severe	0 (0.0)	0 (0.0)	2 (12.5)	2 (3.1)	
DNS type					
0	3 (14.3)	2 (7.4)	0 (0.0)	5 (7.8)	
I	3 (14.3)	1 (3.7)	0 (0.0)	4 (6.3)	
II	7 (33.3)	3 (11.1)	0 (0.0)	10 (15.6)	<0.001
III	5 (23.8)	13 (48.1)	1 (6.3)	19 (29.7)	
IV	2 (9.5)	5 (18.5)	5 (31.3)	12 (18.8)	
V	1 (4.8)	2 (7.4)	6 (37.5)	9 (14.1)	
VI	0	1 (3.7)	1 (6.3)	2 (3.1)	
VII	0	0	3 (18.8)	3 (4.7**)**	

[a] *Fisher's Exact test applied*

MM, Muller's maneuver; grade 1: no obstruction, grade 2: up to 50% obstruction, grade 3: more than 50% but less than 100%, grade 4: complete obstruction. ITH, inferior turbinate hypertrophy; DNS, deviated nasal septum (Mladina Classification).

We recorded the nasoendoscopic findings particularly the types of deviated nasal septum according to Mladina classification, inferior turbinate hypertrophy, as well as the percentage of obstruction seen during Muller's maneuver. The clinical findings were summarized in Table 2. All moderate and severe OSA patients had bi-level obstruction during Muller's maneuver. On the other hand, in mild OSA group, 9.5% patient did not have obstruction at retropalatal level and 23.8% without obstruction at retrolingual level. The degree of obstruction seen at retropalatal and retrolingual level during Muller maneuver were greater in the severe OSA group, in which the percentage of patient with obstruction of more than 50% (grade 3) at retropalatal and retrolingual were 56.3% and 87.4% respectively. Fourty-three percent patient with complete obstruction was seen at retropalatal and 6.3% at retrolingual in the similar group. In moderate OSA group, majority cases (66.6%) had grade 3 obstruction at retropalatal area but at the retrolingual area, majority had grade 2 obstruction (59.3%).

We observed the inferior turbinates for hypertrophy. Only 1 patient had normal inferior turbinates in mild OSA group and 2 patients with severe ITH who suffered severe OSA. Most patients had moderate ITH, 71.4%, 70.4% and 75.0% in mild, moderate and severe OSA group respectively. However, the correlation of ITH with severity of OSA had a p-value of 0.155 which is not statistically significant.

Next we examined the shape of nasal septum for any type of deviation using Mladina classification. Five patients had normal nasal septum. In mild OSA group, type II DNS is the most common type seen with 33.3% followed by type II with 23.8%. Type VI and VII DNS were not seen in mild OSA group. On the contrary, majority of patients with moderate OSA had type III DNS (48.1%) followed by type IV (18.5%) and type II (11.1%). Patients with severe OSA had DNS Mladina type III and above, predominantly type V (37.5%). Three patients of this group had type VII DNS. The association of DNS and severity of OSA was significant with p value of <0.01.

3.6 DISCUSSION

OSA is a condition characterised by sleep-related recurrent airway obstruction resulting in total (apnoea) or partial (hypopoea) reduction of airflow. Risks factor for OSA are age between 40-65, obesity, male, smoking, sedentary lifestyle and alcoholism (1,2). This condition if left untreated can cause a significant morbidities including cardiovascular and neurological complications as well as socioeconomic repercussions. The gold standard investigation to diagnose OSA is through PSG, which also determined the severity of OSA based on AHI (4, 5). There are several physical examinations that can be done in order to predict the likelihood of OSA such as BMI measurement, neck circumference and nasopharyngeal examination (10). MM was first described by Borowieki and Sassin in 1983 to determine the upper airway collapse using a flexible endoscope (11). This technique which is performed during wakefulness has been advocated to be clinically useful not only in predicting the likelihood of OSA but has been used for perioperative airway assessment to predict surgical outcome and to improve patient selection (12). However, the reliability of MM in predicting OSA has been criticized since it is done in awake sitting positing which does not simulate an actual airway obstruction during sleep, as well as its inability to show different obstruction

levels at the same time and this maneuver is highly subjective (9,11). Several studies have concluded that MM does not provide useful data to predict OSAS and its finding does not correlate with severity of OSA (7,8).

To the contrary, Thong and Pang concluded that MM is useful in determining OSA patients as the degree of upper airway collapse is related to severity of OSA based on PSG (13). On the other hand, Oguzhan et al. also favoured MM findings in predicting OSA as they concluded that lateral pharyngeal wall collapse is related to high AHI scores (9). Our study showed the severity of OSA worsens as the grading of obstruction at both retropalatal and retrolingual areas increases. This correlation between MM findings and severity of OSA is highly significant (p-value<0.001).

As nasal airway is an essential component of the upper airway system, its contribution to severity of OSA is not fully understood (14). Physiologically, nasal airway contributes to more than half of total upper airway resistance and during sleep, breathing is primarily via nose unless obstruction in the nasal airway exists (14,15). Although the role of nasal airway in pathophysiology of OSA is not fully understood, most studies on nasal function with acoustic rhinometry and rhinomanometry have shown a diminished nasal volume in OSA patient (1). However, Rodrigues et al. demonstrated that endoscopic nasal findings (DNS/ITH) were more important than nasal airway volume when evaluating OSA patients and such, this anatomical nasal obstruction may be more significant than the low nasal volume in the pathophysiology of OSA (1). Hence we were drawn by this conclusion to evaluate anatomical nasal obstruction in OSA patient.

Current researches showed incongruity regarding association of nasal airway obstruction and severity of OSA. For instance, Leitzen et al. concluded that abnormal intranasal anatomy such as inferior turbinate hypertrophy, nasal septum deviation and nasal valve narrowing do not contribute to objective OSA severity (14). In contrast, Rodrigues et al.

concluded that the presence of nasal airway obstruction due to DNS and/or ITH had a significant correlation with severity of OSA (1). Similar conclusion was made by de Aguir Vidigal et al. with regards to ITH and OSA severity, but not in relation to DNS (16).

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In our study, DNS was found to be significantly associated with severity of OSA but not ITH. 92.2% of our study population had DNS and we used Mladina classification to describe the types of DNS. Mladina classification of DNS was introduced in 1995 in a study to find a relationship between rhinosinusitis and septal deformities (17, 18). This classification of DNS has been accepted by rhinologists worldwide and has been used in many publications (18). Studies have shown that in symptomatic patients, type V DNS is the most common type found (17,19). Similarly, we found that type V is the most common type of DNS in severe OSA group. We also found that the most common type of DNS in mild OSA group was type II and type III in moderate OSA group. With p-value <0.001, any type of DNS on Mladina classification carries a significant association in developing OSA and type V seems to have higher risk to develop severe OSA. With regards to ITH, we conclude that this anatomical abnormality does not have a significant relationship to severity of OSA.

3.7 Conclusion

The cause of OSA is known to be multifactorial and the risks of developing this condition is vast. Although PSG remains the gold standard for diagnosing OSA, the subjective and objective assessments are crucial to help making the diagnosis. Nasoendoscopic examination and MM are indeed important as the findings showed DNS and upper airway obstruction at both retropalatal and retrolingual levels are significantly related to severity of OSA. Type V DNS on Mladina classification seems to be associated with higher risk for severe OSA.

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