International Journal of Research in Medical Sciences
Samta et al. Int J Res Med Sci. 2016 Aug;4(8):3275-3281
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20162279

Research Article

Relation between obstructive airway disease and body mass index in patients with obstructive sleep apnoea

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Received: 01 June 2016
Accepted: 01 July 2016

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ABSTRACT

Background: Obstructive airway diseases are characterized by a limitation of airflow when measured by spirometry. There is also a correlation between sleep quality and the obstructive lung diseases. Therefore, the present study was designed to assess the occurrence of obstructive airway disease by assessing body mass index, neck circumference in patients with obstructive sleep apnoea (OSA).
Methods: Patients with sleep complaints undergoing Polysomnography for diagnosis of OSA in Department of Pulmonary Medicine were enrolled for the study. After the ethical clearance and informed consent, grading of breathlessness was done by MMRC Dyspnea scale. An in-house sleep questionnaire with Epworth Sleepiness scale score of 0 to 3 was administered. The clinical examination included the measurement of Body mass index, Neck circumference and Mallampatti score. The data were represented as percentages and mean + SD. Chi-square test and student't' test was used to determine the statistical difference and a "p" value of less than 0.05 was considered the level of significance.
Results: The PFT and age in patients with obstruction (FEV1/FVC<70) was statistically significant (p=0.011) whereas, that in patients with obstruction (FEV1/FVC<75) was statistically insignificant (p=0.843). The PFT and BMI in patients with Obstruction (FEV1/FVC<70) and (FEV1/FVC<75) was found to be statistically insignificant (p=0.869 and 0.869).
Conclusions: The Patients with Obstructive airway disease also showed frequent oxygen de-saturations and had high Respiratory Distress Index. The Patients with Obstructive airway disease had severe OSA.

Keywords: Polysomnography, Obstructive sleep apnoea, MMRC Dyspnea scale, Obstructive airway diseases

INTRODUCTION

Obstructive sleep apnea (OSA) is characterized by repeated episodes of upper airway obstruction that results in brief periods of complete breathing cessation (apnea) or a marked reduction in airflow (hypopnea) during sleep. OSA is the most severe form of obstructive sleep-disordered breathing (SDB). OSA is a common disorder with a prevalence estimated at 10-20%.[1,2] Risk factors for OSA include male gender, age, obesity, upper airway anatomy (tonsillar enlargement, nasal septal deviation, Mallampatti class III/IV airway, retrognathia), hypothyroidism, genetic factors, alcohol and nocturnal nasal congestion.[3]

Obstructive airway diseases (OAD) are characterized by a limitation of airflow when measured by spirometry. asthma and chronic obstructive pulmonary disease (COPD) are the two most common forms of obstructive lung diseases. Asthma is characterized by reversible airway obstruction caused by inflammation of the lung's airways, often as a response to various triggers. COPD is

characterized by airway obstruction that is not fully reversible.

There is also a correlation between sleep quality and the obstructive lung disease.[4] People with COPD and those with asthma have been shown to have worse sleep quality and more sleep-related problems when compared to people with other chronic health problems. Sleep fragmentation and resultant sleep deprivation can lead to excessive daytime sleepiness (EDS) and contribute to poor daytime cognitive function leading to social and mental problems. It has also been suggested that there may be a pathologic relationship between OSA and OAD.[5] The association of COPD and OSA was defined Overlap Syndrome.[6] The two disorders coexist (overlap syndrome) in approximately 1% of adults but asymptomatic lower airway obstruction together with sleep-disordered breathing is more prevalent.[5] The prevalence of OSA among patients with COPD is similar to that of the general population while the prevalence of obstructive airway disease among patients with OSA is even higher.[7,8]

COPD and OSA are prevalent worldwide and their effect becomes even higher when these diseases coexist. The overlap syndrome is associated with worst pulmonary implications, systemic consequences, morbidity and mortality than those of either COPD or OSA alone.[9] Due to these consequences of the overlap syndrome, it is recommended to actively search for its existence, and to treat it with continuous positive airway pressure (CPAP) concurrently with oxygen and optimal pharmacological treatment.[10] Although several studies provided data for the prevalence of the individual disease, there are no large prevalence studies of the association of OAD with OSA.

This lack of studies is likely because of methodological limitations, including absence of a diagnostic code for the syndrome and absence of data in large cohort studies completed in the past. There are several small epidemiologic analyses from the United States and overseas indicating increased prevalence of OSA in individuals who have COPD or Asthma. There seems to be an increased prevalence of COPD or asthma in individuals who have OSA also.[11] With this background, the present study was designed to assess the occurrence of Obstructive Airway Disease by assessing Body Mass Index, Neck Circumference in patients with Obstructive Sleep Apnea.

METHODS

The present study was undertaken after the institutional ethical clearance and written and informed consent from all the patients. Patients with sleep complaints undergoing polysomnography for diagnosis of OSA in Department of Pulmonary Medicine were enrolled for the study. Patients with congestive cardiac failure, stroke, hemoptysis and acute myocardial infarction were excluded from the study. After taking informed consent, patients are subjected to history of symptoms, personal and past history was taken. Grading of Breathlessness was done by MMRC (Modified Medical Research Council) Dyspnea scale.

An in-house sleep questionnaire with Epworth Sleepiness scale score of 0 to 3 was (0=would never doze, 1=slight chance of dozing, 2=moderate chance of dozing and 3=high chance of dozing). The clinical examination included the measurement of body mass index (BMI), Neck circumference and Mallampatti score. The presence or absence of obstructive sleep apnea was determined from polysomnographic analysis with manual scoring of sleep staging and respiratory events by an experienced sleep technologist.

Statistical analysis

The discrete data for each parameter was represented as numbers and percentages and continuous data as mean + standard deviation. Proportions were compared using Chi-square test of significance. The student‘t’ test was used to determine whether there was a statistical difference between groups in the parameters measured. A “p” value of less than 0.05 was accepted as indicating statistical significance. Data analysis was carried out using Statistical Package for Social Science (SPSS, V 10.5) package.

RESULTS

Out of one hundred and two OSA patients, among males the age distribution was clustered around 40-70 years (55 patients), and among females age distribution was clustered around 50-70 years (58 patients).OSA was found in 2 male patients less than 30 years of age. Females are affected at older age and males are affected at younger age (Table 1).

Table 1: Distribution DF age and gender.

AGE	Sex		Total
	Male	Female	
<30 years	2	0	2
	100.0%	0%	100.0%
30-39 years	14	3	17
	82.4%	17.6%	100.0%
40-49 years	18	3	21
	85.7%	14.3%	100.0%
50-59 years	20	11	31
	64.5%	35.5%	100.0%
60-69 years	17	10	27
	63.0%	37.0%	100.0%
70-79 years	3	1	4
	75.0%	25.0%	100.0%
Total	74	28	102
	72.5%	27.5%	100.0%

The BMI distribution in study group in males are grouped mainly around the Overweight and Obesity groups and in the females in the obesity groups which was found to be statistically significant (P=0.007 HS). Among 13 patients with an obstruction (FEV1/FVC<75), majority of the patients (61.6%) were above 50 years of age.

Table 2: Distribution of body mass index and gender.

Gender	Body mass index					Total	'p' value
	Normal	Overweight	Class- I obesity	Class- II obesity	Class-III obesity		
Male	5	33	15	15	6	74	0.007 HS
	6.8%	44.6%	20.3%	20.3%	8.1%	100.0%	
Female	1	2	10	11	4	28	
	3.6%	7.1%	35.7%	39.3%	14.3%	100.0%	
Total	6	35	25	26	10	102	
	5.9%	34.3%	24.5%	25.5%	9.8%	100.0%	

Table 3: Distribution of PFT and age in patients with obstruction (FEV1/FVC<70).

Age in years	PFT-FEV1/FVC		Total	'p' value
	<70	**≥70**		
<30 years	1	1	2	**0.011**
	14.3%	1.1%	2.0%	
30-39 years	3	14	17	
	42.9%	14.7%	16.7%	
40-49 years	0	21	21	
	0.0%	22.1%	20.6%	
50-59 years	0	31	31	
	0.0%	32.6%	30.4%	
60-69 years	2	25	27	
	28.6%	26.3%	26.5%	
70-79 years	1	3	4	
	14.3%	3.2%	3.9%	
Total	7	95	102	
	100.0%	100.0%	100.0%	

Table 4: Distribution of PFT and age in patients with obstruction (FEV1/FVC<75).

Age in years	PFT-FEV1/FVC		Total	'p' value
	<75	≥75		
<30 years	1	1	2	0.081
	7.7%	1.1%	2.0%	
30-39 years	4	13	17	
	30.8%	14.6%	16.7%	
40-49 years	0	21	21	
	0.0%	23.6%	20.6%	
50-59 years	2	29	31	
	15.4%	32.6%	30.4%	
60-69 years	5	22	27	
	38.5%	24.7%	26.5%	
70-79 years	1	3	4	
	7.7%	3.4%	3.9%	
Total	13	89	102	
	100.0%	100.0%	100.0%	

Table 5: Distribution of PFT and BMI in patients with Obstruction (FEV1/FVC<70)

Body mass index	PFT-FEV1/FVC		Total	'p' value
	<70	≥70		
Normal (18.5-24.9)	1	6	7	
	14.3%	6.3%	6.9%	
Overweight (25.0-29.9)	2	32	34	
	28.6%	33.7%	33.3%	
Class I Obesity (30.0-34.9)	2	23	25	
	28.6%	24.2%	24.5%	
Class II Obesity (35.0-39.9)	1	25	26	
	14.3%	26.3%	25.5%	
Class III Obesity (≥40.0)	1	9	10	0.843
	14.3%	9.5%	9.8%	
Total	7	95	102	
	100.0%	100.0%	100.0%	

Table 6: Distribution of PFT and BMI in Patients with Obstruction (FEV1/FVC<75).

Body mass index	PFT-FEV1/FVC		Total	'p' value
	<75	≥75		
Normal (18.5-24.9)	1	6	7	
	7.7%	6.7%	6.9%	
Overweight (25.0-29.9)	3	31	34	
	23.1%	34.8%	33.3%	
Class I Obesity (30.0-34.9)	3	22	25	
	23.1%	24.7%	24.5%	0.869
Class II Obesity (35.0-39.9)	4	22	26	
	30.8%	24.7%	25.5%	
Class III Obesity (≥40.0)	2	8	10	
	15.4%	9.0%	9.8%	
Total	13	89	102	

There is no statistically significant difference between age group and patients with or without obstruction (p=0.081NS, Table 2). Distribution of PFT and age in patients with obstruction (FEV1/FVC<70) was statistically significant (p=0.011, Table 3) whereas, PFT and age in patients with obstruction (FEV1/FVC<75) was statistically insignificant (p=0.843, Table 4).

Distribution of PFT and BMI in patients with Obstruction (FEV1/FVC<70) and (FEV1/FVC<75) was found to be statistically insignificant (p = 0.869 and 0.869, Table 5 and 6).Table 7 indicates the distribution of PFT and PSG Parameters in Patients with Obstruction (FEV1/FVC<75). The Mean Heart Rate during the PSG in the OAD group and No OAD group was not statistically significant (p=0.943).

The arousal index in the OAD group and No OAD group was not statistically significant (p=0.309). The RDI in the OAD group and No OAD group was not statistically significant (p=0.440, Table 7).

DISCUSSION

Several studies have investigated the association between OSA and obstructive airway disease (OAD), including both asthma and chronic obstructive airway disease (COPD). A high prevalence of OSA has been reported in asthma clinics, and asthma may also be common in OSA.[12] Several reports stressed that OSA may contribute to asthma symptoms and its severity.

Obstructive sleep apnea syndrome is defined as repeated episodes of obstructive apneas and hypopneas during sleep, frequently followed by transient hemoglobin de-saturation (hypoxemia) and unconscious (EEG) arousals. Snoring, episodes of dyspnea, asphyxia or suffocation and body movements are common between apnoeic events; and can cause sleep fragmentation.

Feeling of unrefreshing sleep, exhaustion and daytime sleepiness (which is the most common symptom) can severely impair quality of life of the patients. OSAS is considered as an independent risk factor for development

of systemic arterial hypertension and cardiovascular events. Its prevalence, using the most rigid diagnostic criteria, is estimated to be 4% and 2% in middle-aged men and women respectively.[13]

Table 7: Distribution of PFT and PSG Parameters in Patients with Obstruction(FEV1/FVC<75) .

PSG	FEV1/FVC	N	Mean	SD	Min.	Max.	't' value	'p' value
Sleep Efficiency	**<75**	13	87.408	13.0078	58.6	97.9	0.021	0.884
	≥75	89	88.012	14.0935	33.0	100.0		
Stage I	**<75**	13	25.692	27.9310	4.0	95.7	0.272	0.603
	≥75	89	29.676	25.3988	0.0	100.0		
Stage II	**<75**	13	41.354	20.3128	4.3	70.2	1.125	0.291
	≥75	89	48.065	21.4429	0.0	89.5		
Stage III	**<75**	13	26.231	22.2979	0.0	71.9	4.736	**0.032**
	≥75	89	15.516	15.6429	0.0	67.0		
REM	**<75**	13	6.715	12.0841	0.0	42.5	0.000	0.989
	≥75	89	6.679	8.3052	0.0	28.4		
Sleep Latency(Mins)	**<75**	13	22.846	28.9651	3.0	107.5	0.461	0.499
	≥75	89	17.573	25.7452	1.5	171.0		
Lowest Spo2	**<75**	13	72.154	17.2184	36.0	90.0	0.090	0.765
	≥75	89	73.539	15.3372	20.0	91.0		
Mean HR	**<75**	13	91.615	7.2289	84.0	107.0	0.005	0.943
	≥75	89	91.790	8.3211	74.0	118.0		
Arousal Index	**<75**	13	23.169	15.4341	10.0	58.3	1.046	0.309
	≥75	89	29.646	22.0141	0.0	105.6		
RDI(/HR)	**<75**	13	54.869	28.0442	13.8	107.3	0.602	0.440
	≥75	89	62.285	32.7162	6.7	142.5		
PFT-FEV1	**<75**	13	1.672	0.4750	0.7	2.4	4.209	**0.043**
	≥75	89	2.121	0.7663	0.6	4.0		

Obesity is the major risk factor for the development of OSA; it is thought to be associated with anatomic alterations that predispose to upper airway obstruction during sleep, by increasing adiposity around the pharynx and body. Central obesity has been associated with reduction in lung volume, which leads to a loss of caudal traction on the upper airway, and hence, an increase in pharyngeal collapsibility.[14] In a community-based cohort of middle-aged Caucasian subjects, a 1-SD increase in body mass index was associated with a four-fold rise in the prevalence of sleep apnoea, and 40 % of subjects from the community with OSA were moderately overweight but otherwise healthy.[15] In subjects with severe obesity, BMI of >40, the prevalence of sleep apnoea was markedly increased to 40-90 %.[16]

Although asthma and COPD are considered distinct disorders, there is significant overlap between them present with features of both and respond to similar therapies, hinting that these may be actually different phenotypes of the same condition (the 'Dutch hypothesis').

Additionally, there is increased recognition that a dual interaction between asthma or COPD and OSA exists beyond random coexistence. On one hand, there is increased prevalence of OSA in asthma/ COPD. Furthermore, prospective studies find asthma as a risk factor for snoring, independent of possible confounders, such as BMI.

These relationships may stem in part from a set of factors unique to these patients, related to disease severity, comorbidities, corticosteroid medications, aside from obesity and other traditional risk factors for OSA. Conversely, current data suggest worse asthma and COPD outcomes in patients with coexistent OSA, and that treatment for OSA improves disease control indices, reduces exacerbations and mortality. Again, several overlapping pathways may be at play in this direction as well.[17,18] Flenley considered that multiple respiratory diseases could "overlap" in the same individual.[6]

The association of COPD and OSA was defined as Overlap Syndrome.[6] While the term overlap syndrome has been used for the association OSA– COPD, one has not been coined for OSA–asthma. A distinct, broader clinical entity or 'integrated' overlap syndrome, that is OLDOSA (obstructive lung disease and obstructive sleep apnoea) syndrome, is proposed.[19]

Possible shared mechanistic links include increased parasympathetic tone, hypoxaemia-related reflex bronchoconstriction/ vasoconstriction, irritation of upper airway neural receptors, altered nocturnal neurohormonal secretion, proinflammatory mediators, within and inter-breath interactions between upper and lower airways, lung volume-airway dependence.[19,20]

CONCLUSION

Majority of the patients with obstruction were in age group 60-69 years and were males and belong to obesity group with class III Mallampatti score. The Patients with Obstructive airway disease also showed frequent oxygen desaturations and had high Respiratory Distress Index. The Patients with Obstructive airway disease had severe OSA.

Further studies with a larger study population may be needed to know the exact prevalence of overlap syndrome. The results found in our study may not be extrapolated to general population as it is a study done on a small population. Follow up prospective studies involving overlap syndrome patients may be needed to know the prognosis, morbidity, mortality and treatment in comparison to standard OSA patients.

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: Samta, Surynarayana HV, Chandrashekhar HB, Prasad HL Relation between obstructive airway disease and body mass index in patients with obstructive sleep apnoea. Int J Res Med Sci 2016;4:3275-81.