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Assessment of severity of sleep apnea in obstructive airway diseases patients at tertiary care hospital

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ABSTRACT

Background: Obstructive sleep apnea if remains untreated can lead to excessive daytime sleepiness, diminished performance and overall poor quality of life. Factors that increase vulnerability of sleep apnea include age, male sex, obesity, family history, craniofacial abnormalities and certain health behaviors such as alcohol abuse and smoking. Previously diagnosed cases of COPD and bronchial asthma (as per guidelines) having symptoms of obstructive sleep apnea were also included in this study. This present study was planned to study assessing of severity of sleep apnea in obstructive airway diseases patients.

Materials and Methods: The present study was conducted in sleep laboratory of the Department of Pulmonary Medicine of a tertiary care hospital that caters to population of diverse groups. Patients after clinical examination and spirometry with post bronchodilator reversibility were categorized into bronchial asthma and COPD. Subsequently, polysomnography was done of these patients to study the sleep pattern.

Results: Amongst patients with COPD, 11 (16.42%) had mild COPD, 26 (38.80%) had moderate COPD, 22 (32.84%) had severe COPD and 08 (11.94%) patients had very severe COPD. 38.71% and 29.03% that is 12 and 09 out of 31 patients had moderate and severe asthma respectively. Again 19.36% and 12.90% that is 06 and 04 patients had mild persistent and intermittent asthma respectively. 17(25.37%) patients of COPD were found to have obstructive sleep apnea and 09 (29.03%) patients of asthma had obstructive sleep apnea.

Conclusions: In patients with overlap syndrome had more severe hypercapnia (mean $PaCO_2$ 48.88 $\pm$0.017), and nocturnal desaturation (mean 85.35% $\pm$0.022) Patients having moderate COPD had severe OSA. Patients having severe asthma had severe OSA with correlation coefficient R = -0.527 with p value <0.001 meaning negative linear correlation between AHI and % FEV1 of predicted of asthma patients.

1. Introduction

Obstructive sleep apnea if remains untreated can lead to excessive daytime sleepiness, diminished performance and overall poor quality of life. Factors that increase vulnerability of sleep apnea include age, male sex, obesity, family history, craniofacial abnormalities and certain health behaviors such as alcohol abuse and smoking.[1] Obstructive sleep apnea syndrome is a potentially disabling condition in which disruptive snoring, repeated complete or partial collapse of upper airway occurs leading to nocturnal hypoxemia, frequent arousal and excessive daytime sleepiness. However, new research in biochemistry and genetics of this disorder lead us to its cure. Continuous positive airway pressure (CPAP) therapy remains the first line of treatment. Although its acceptance is low due to high cost and long term use, it leads to improvement in

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quality of life, improvement in metabolic derangements that occurs in OSA patients as well as prolongs the life with good compliance of therapy.[2,3] Other options available are drugs, oral appliances and upper airway surgeries.[2,3] Apnea-Hypo apnea Index (AHI) is widely used for the diagnosis and assessment of severity of OSA. AHI refers to mean number of apneas or hypopneas per hour of sleep. AHI of >5 is suggestive of OSA.

Hypopnea is characterized by polysomnographic variables as any one of these.

1. Decrease in nasal airflow by >50% for >10 sec.
2. Decrease in nasal airflow by less than 50% with up to 4% fall in oxygen saturation.
3. Decrease in nasal airflow by less than 50% with electroencephalographic evidence of arousal.

Apnea is defined as complete cessation of nasal air flow for >10 seconds.[2]

Polysomnography is considered "gold standard" for diagnosis, but it is not without limitations. It requires an overnight stay in a sleep laboratory staffed with qualified personnel that can collect and interpret complex physiological data. Obstructive sleep apnea prevalence varies in different population. In most of the studies it varies from 3-7%.[4] Prevalence of OSA in India is 7.5% in males and that of 4.5% in females.[5] All patients of COPD and bronchial asthma diagnosed as per guidelines and those fulfilling the criteria for diagnosis of obstructive sleep apnea were included in the study.

Previously diagnosed cases of COPD and bronchial asthma (as per guidelines) having symptoms of obstructive sleep apnea were also included in this study. This present study was planned to study assessing of severity of sleep apnea in obstructive airway diseases patients.

2. Material and Methods

The present study was conducted in the sleep laboratory of the Department of Pulmonary Medicine of a tertiary care hospital that caters to population of diverse groups. This was a prospective study carried over a period of 18 months. Institutional ethical committee approval was obtained for this study. Sample size estimation was done with expert statistician.

Patients after clinical examination and spirometry with post bronchodilator reversibility were categorized into bronchial asthma and COPD. Subsequently polysomnography was done of these patients to study the sleep pattern.

2.1. Inclusion criteria

1. Patients having COPD and bronchial asthma diagnosed as per guidelines and having symptoms and signs of obstructive sleep apnea.
2. Patients having obstructive sleep apnea diagnosed as per guidelines.
3. Those with Age >13 yrs.
4. Patients giving informed consent.

2.2. Exclusion criteria

1. Age < 13 yrs.
2. Patients having chronic lung diseases not satisfying guidelines for diagnosis of COPD, bronchial asthma and OSA
3. Patients admitted with life threatening conditions like acute respiratory failure, critical metabolic acidosis, altered sensorium, hypotension, left ventricular failure
4. Acute exacerbation of COPD/bronchial asthma, acute myocardial infarction, acute stroke
5. Uncooperative patients
6. Patients not giving consent

All the patients included in the study were interviewed for demographic data and detail history of their illness.

Diagnosis of COPD was based on Global Initiative for Obstructive Lung Disease guidelines i.e. cough with sputum production for most of the days in a year atleast 3 months for 2 consecutive years or dyspnea with history of exposure for risk factors (e.g. tobacco smoking), progressive breathlessness and spirometry showing FEV1/FVC less than 70% and FEV1 less than 80% predicted with poor bronchodilator reversibility (i.e. improvement in FEV1 <12% and 200ml). Also patients with mixed ventilator disorder were included in COPD patients, as all of them had poor bronchodilator response on Spirometry.[6]

COPD patients were further staged as mild, moderate, severe, very severe as per the GOLD guidelines.

The apnea-hypopnea index (AHI-the number of apneas plus hypopneas per hour of sleep) is the standard metric used to quantitate the severity of obstructive sleep apnea.[7]

Although the AHI has been proven to be superior metric when assessing the overall effect of OSA, it excludes the degree of oxygen desaturation, degree of hypoventilation, and total number of arousals. An AHI greater than 5 to 10 events per hour is indicative of OSA. The obstructive sleep apnea syndrome (OSAS) is said to be present when the AHI is greater than 5 to 10 events per hour and the patient has symptoms of excessive daytime somnolence, unrefreshing sleep, or chronic fatigue.

3. Diagnostic Criteria for Adult Obstructive Sleep Apnea

3.1. At least one of the following applies:

1. The patient complains of unintentional sleep episodes during wakefulness, daytime sleepiness, unrefreshing sleep, fatigue, or insomnia.

2. The patient wakes holding his/her breathe, gasping, choking
3. The bed partner reports loud snoring or breathing interruptions during the patient's sleep

3.2. Polysomnographic recording shows the following:

1. Five or more scoreable respiratory events occur per hour. These events can include any combination obstructive apneas, hypopneas, or respiratory-associated arousals.
2. There is evidence of respiratory effort during all portion of each respiratory event

3.3. Polysomnographic recording shows the following:

1. Fifteen or more scoreable respiratory events (i.e., apneas, hypopneas, or RERAs) per hour of sleep
2. Evidence of respiratory effort during all or a portion of each respiratory event (In the case of a RERA, this is best seen with the use of esophageal manometry)

3.4. This disorder is not better explained by another

4. Results

Total 98 patients of COPD, bronchial asthma and obstructive sleep apnea who satisfied all the inclusion criteria attending a tertiary care centre were studied over a period of 18 months.

With the help of a proforma data was meticulously collected and entered in the MS EXCEL spreadsheet and analyzed. On analysis of the data following observations and results were found in the present study. Patients included in the present study were divided after spirometry as per post bronchodilator FEV1 reversibility as, those with asthma (>12% or 200 ml reversibility in FEV1) and those with COPD (<12% or 200 ml reversibility in FEV1)

Amongst total 98 patients, 67(68.37%) were of COPD and 31(31.63%) were of bronchial asthma. Majority of patients having COPD were in the age group of 45-54 years and 55-64 years, 52.23% and 23.88% respectively. Majority of patients having bronchial asthma were in the age group of 35-44 years 51.62%. Amongst COPD patients 51(76.12%) were males and 16(23.88%) were females, male to female ratio in COPD was 3.19:1. Amongst patients with asthma 18(58.06%) were males and 13(41.94%) were females, with male to female ratio of 1.39:1.

In the total study population of 98 patients 69(70.41%) were males and 29(29.59%) were females.

Table 1: Showing active smoking in study population

Disease(n)	Smokers	Nonsmokers	Total
COPD (n=67)	55(82.09%)	12(17.91%)	67(100%)
Asthma (n=31)	10(32.26%)	21(67.74%)	31(100%)

55 (82.09%) amongst 67 patients with COPD were smokers and 12 (17.91%) were non smokers, smokers to nonsmokers ratio was 4.58:1. In asthma 10 (32.26%) patients were smokers and 21(67.74%) patients were non-smokers. In COPD patients bidi smoking was common seen in 48(87.27%) patients, than cigarette smoking seen in 07(12.73%) patients and among asthmatic patients, 08 were bidi smokers and 02 were cigarette smokers. Not in the above table is history of chullah smoke exposure among the nonsmoker COPD patients, found in 08 patients, and in total asthmatic patients it was found in 05 patients.

Body mass index was normal [BMI 18.5-24.99] in 53(54.08%) patients, 18(18.37%) patients were overweight [BMI 25-29.99] amongst this group, obesity [BMI >30] was found in 27(27.55%) patients having COPD and bronchial asthma.

Table 2: Showing most common symptoms of obstructive airway diseases in the study population

Symptoms	COPD (n=67)	Asthma (n=31)
Breathlessness	55 (82.09%)	27 (87.10%)
Cough	41 (61.19%)	24 (77.42%)
Chest tightness	31 (46.26%)	13 (41.94%)
Wheeze	18 (26.87%)	26 (83.87%)

Amongst patients with COPD, breathlessness was the most common symptom seen in 55(82.09%) patients, followed by cough in 41(61.19%) patients, chest tightness in 31(46.26%) patients and wheeze in 18(26.87%) patients. In patients having bronchial asthma, breathlessness was the most common symptom seen in 27(87.10%) patients, followed by wheeze in 26(83.87%) patients, cough in 24(77.42%) patients and chest tightness in 13(41.94%) patients.

Table 3: Showing most common symptoms of obstructive sleep apnea in the study population

Symptoms	Total patients (n=98)	Patients with OSA (n=26)
Loud, habitual snoring	62 (63.26%)	20 (76.92%)
Excessive daytime sleepiness	30 (30.61%)	16 (61.54%)
Nocturnal awakening	28 (28.57%)	12 (46.15%)
Memory loss and personality changes	02 (2.04%)	01 (3.85%)

Most common symptom of OSA in study population was snoring, present in 62(63.26%) patients, excessive daytime sleepiness in 30(30.61%), nocturnal awakening in 28(28.57%) and memory loss, personality changes in 02(2.04%) patients. Amongst patients with OSA, snoring was seen in 20(76.92%), excessive daytime sleepiness in 16(61.54%), nocturnal awakening in 12(46.15%) and memory loss and personality change in 01(3.85%) patients.

Table 4: Showing distribution in patients with COPD as per stages of severity, according to GOLD guidelines (n=67)

Severity	Total	Percentage
Mild	11	16.42%
Moderate	26	38.80%
Severe	22	32.84%
Very severe	08	11.94%
Total	67	100%

Amongst patients with COPD, 11(16.42%) had mild COPD, 26(38.80%) had moderate COPD, 22(32.84%) had severe COPD and 08(11.94%) patients had very severe COPD.

Table 5: Showing distribution of patients having bronchial asthma as per per stages of severity, according to GINA guidelines (n=31)

Severity	Total	Percentage
Intermittent	04	12.90%
Mild persistent	06	19.36%
Moderate	12	38.71%
Severe	09	29.03
Total	31	100%

38.71% and 29.03% that is 12 and 09 out of 31 patients had moderate and severe asthma respectively. Again 19.36% and 12.90% that is 06 and 04 patients had mild persistent and intermittent asthma respectively.

Table 6: Showing presence of obstructive sleep apnea in COPD and bronchial asthma

	Without OSA	With OSA	Total
COPD	50 (74.63%)	17 (25.37%)	67
Asthma	22 (70.97%)	09 (29.03%)	31
Total	72 (73.47%)	26 (26.53%)	100

17(25.37%) patients of COPD were found to have obstructive sleep apnea and 09 (29.03%) patients of asthma had obstructive sleep apnea.

Table 7: Age distribution in OSA patients (n=26)

Age in years	COPD with OSA	Asthma with OSA	Total
14-24	00	00	00 (0%)
25-34	00	01	01 (3.85%)
35-44	01	04	05 (19.23%)
45-54	04	03	07 (26.92%)
55-64	07	01	08 (30.77%)
65-74	04	00	04 (15.38%)
75-84	01	00	01 (3.84%)
Total	17 (100%)	09 (100%)	26 (100%)

Among 26 patients of OSA 20 patients (76.92%) were in the age group of more than 45 years suggesting that OSA is more prevalent in middle and elderly patients of the study population.

Table 8: Showing correlation of smoking and obstructive sleep apnea (n=26)

	COPD with OSA	Asthma with OSA	Total
Smokers	14	02	16 (61.54%)
Non-smokers	03	07	10 (38.46%)
Total	17	09	26 (100%)

Out of 26 patients of OSA, 16(61.54%) were smokers of which 14 patients had COPD and 02 patients had bronchial asthma. 10(38.46%) patients were non smokers.

Out of 26 patients of obstructive sleep apnea 19 patients (73.08%) had mild to severe obesity, 06 patients (23.08%) were overweight and only 01 patient (3.85%) was having normal body mass index. It was observed that obesity is risk factor for the development of obstructive sleep apnea in the study population.

Out of 17 patients of obstructive sleep apnea 08(47.06%) patients had severe COPD, 06(35.29%) patients had moderate COPD and 03(17.65%) patients had very severe COPD.

Patients of overlap syndrome were having higher BMI (32.61 $\pm$4.23) than that of COPD alone (24.65 $\pm$3.99). Patients with overlap syndrome were having more severe hypercapnia (mean $PaCO_2$ 48.88 $\pm$0.017) than that of COPD alone (mean $PaCO_2$ 46.02 $\pm$0.03). They were having more severe hypoxemia (mean PaO2 69.65 $\pm$0.012) than that of COPD alone (mean PaO2 72.16 $\pm$0.025).

Patients with overlap syndrome were having more severe nocturnal desaturation (mean 85.35% $\pm$0.022) than COPD alone (mean 92.48% $\pm$0.015). Mean FEV_1 of patients having overlap syndrome was 43.47% $\pm$14.31 versus 55.34% $\pm$17.81 in patients of COPD alone.

Out of 09 patients of obstructive sleep apnea 04(44.44%) had severe asthma, 03(33.33%) patients had moderate asthma and 02 patients (22.22%) had mild asthma. This suggests that severity of asthma is one of the predictor of severity of OSA in patients of bronchial asthma.

It was also observed that in patients having severe OSA, 07 out of 09 patients had more severe grade of bronchial asthma.(FEV1 <80%)

Correlation coefficient was -0.527 as calculated with scatter diagram showed negative linear correlation of AHI with % FEV1 of predicted of Asthma patients.

5. Discussion

In the study population risk factors that were observed for the development of OSA were middle to elderly age (>45 years), male sex, obesity, smoking, and ear nose throat (ENT) pathologies (nasal polyps). These are the same factors that are responsible for the development of OSA in general population. As observed in table no. 2 in the present study amongst patients having COPD, breathlessness was

Table 9: Showing correlation of obesity and obstructive sleep apnea (n=26)

BMI	Normal (18-24.99)	Overweight (25-29.99)	Mild obesity (30-34.99)	Moderate obesity (35-39.99)	Severe obesity (≥ 40)	Total
Mild OSA (AHI 5-15)	00	05	02	00	00	07(26.92%)
Moderate OSA (AHI 15-30)	01	01	07	05	00	14(53.85%)
Severe OSA (AHI >30)	00	00	01	02	02	05(19.23%)
Total	01(3.85%)	06(23.08%)	10(38.46%)	07(26.92%) 19(73.08%)	02(7.69%)	26(100%)

Table 10: Obstructive sleep apnea in COPD patients (n=17)

	Mild COPD	Moderate COPD	Severe COPD	Very severe COPD
Mild OSA	00	05	00	00
Moderate OSA	00	01	07	02
Severe OSA	00	00	01	01
Total	00 (0%)	06(35.29%)	08(47.06%)	03(17.65%)

Table 11: Showing comparison of spirometric, ABG and polysomnographic parameters of patients having COPD and overlap syndrome

Characteristic	COPD without OSA (n=50)	COPD with OSA (n=17)
BMI (mean)	24.65(±3.99)	32.61(±4.23)
Mean PaO2 (mmHg)	72.16(±0.025)	69.65(±0.012)
Mean PaCO2 (mmHg)	46.02(±0.03)	48.88(±0.017)
Mean lowest nocturnal saturation (SaO2%)	92.48%(±0.015)	85.35%(±0.022)
FEV1 mean %	55.34%(±17.81)	43.47%(±14.31)

Table 12: Showing correlation of severity of obstructive sleep apnea with severity of bronchial asthma (n=9)

	Mild asthma (FEV1 ≥ 80%)	Moderate asthma (FEV1 60-80%)	Severe asthma (FEV1 <60%)
Mild OSA	02	00	00
Moderate OSA	00	02	02
Severe OSA	00	01	02
Total	02 (22.22%)	03 (33.33%)	04 (44.44%)

Table 13: Shows risk factors that were observed for the development of OSA in the present study (n=26)

Risk factors	COPD with OSA (n=17)	Asthma with OSA (n=9)	Total
Age >45 years	16	04	20(76.92%)
Male sex	13	07	20(76.92%)
Obesity	12	07	19(73.08%)
Smoking	14	02	16(61.54%)
Nasal polyp	00	01	01(3.85%)

the commonest symptom seen in 55 (82.09%) patients, followed by cough in 41 (61.19%) patients, chest tightness in 31 (46.26%) patients and wheeze in 18 (26.87%) patients.

This correlates with the study done by Kessler in the population of France on 2441 patients found that breathlessness (72.8%) was the commonest symptom in COPD followed by cough (58.7%).[8] Our findings are also comparable with the study done by Kesten in COPD patients in California on 2678 patients in the year 2005 found that dyspnea was the commonest symptom (71%) in COPD followed by cough (19%).[9]

As observed in table no. 6 in patients having bronchial asthma, breathlessness was the most common symptom seen in 27(87.10%) patients, followed by wheeze in 26(83.87%) patients, cough in 24(77.42%) patients and chest tightness in 13(41.94%) patients. This correlates with the text mentioned in Crofton and Douglas that breathlessness is the most common symptom in bronchial asthma.(6) In the study done by Sistek et al., on 9651 patients in Swiss published in the year 2001 found

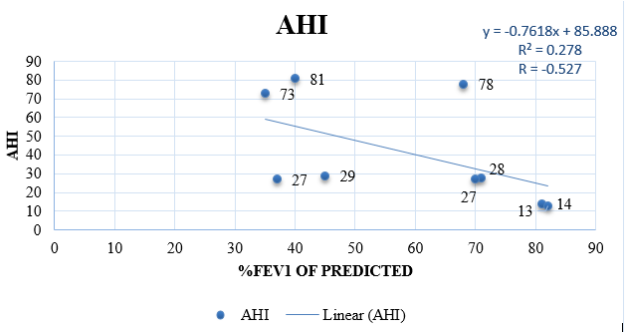

Fig. 1: Scatter diagram showing negative linear correlation between severity of bronchial asthma and severity of obstructive sleep apnea. R = -0.527 and p value <0.001 which is statistically significant.

that wheezing (94.4%) was the commonest symptom in bronchial asthma followed by exertional dyspnea (82%).[10]

As observed in table no. 8 in the present study amongst patients with COPD, 11(16.42%) had mild COPD, 26(38.80%) had moderate COPD, 22(32.84%) had severe COPD and 08 (11.94%) patients had very severe COPD.

Table 14:

Severity	Present study	Seemungal et al.,[11]	Hoogendoorn et al.,[12]	Joshi et al.,[13]
Mild	16.42%	5.3%	27%	30%
Moderate	38.80%	43%	55%	37%
Severe	32.84%	35.1%	15%	33%
Very severe	11.94%	15.9%	03%	0%
Population	67	720	-	268

Present study findings correlates with Seemungal et al., and Harrinarine et al., study where most of the patients had moderate to severe disease.[11] As observed in Table no. 9 in the present study, 38.71% and 29.03% that is 12 and 09 out of 31 patients had moderate and severe asthma respectively. Again 19.36% and 12.90% that is 06 and 04 patients had mild persistent and intermittent asthma respectively.

In the study done by Gothi et al., on patients of bronchial asthma in Mumbai on 268 patients in the year 2001 found that 42% patients had mild asthma, 35% patients had moderate asthma and 22% patients had severe asthma.[13]

Polysomnography was used to study the presence of obstructive sleep apnea and to study the sleep pattern in the study population. As observed in table no. 11 and 18, mean age for patients of OSA was 53.46 years (SD ±12.53), and among total 26 patients of OSA, 20 patients (76.92%) were in the age group of more than 45 years suggesting that OSA is more prevalent in middle and elderly patients of the study population.[4,14] These findings correlate with following studies.

Along with advances in healthcare technologies found us more rationale.[15,16]

Table 15:

Study done	Mean age
In the present study	Mean age was 49.20 years SD ±2.43
Joaquin Duran, Santialo Esnaola, Ramon Rubio and Angeles Iztueta, done in the population of Spain on 442 patients in year 1993-97[17]	Mean age for men was 52 years and that of women was 47.4 years
Surendra kumar Sharma, Saket Kumpawat, Amit Banga and Ashish Goel, study done in the population of Delhi on 150 patients in year 2003-05[18]	Mean age in patients with OSA was 46.7 ±9.3 years
Emmanuel Weitzenblum, multicentric study done in OSA patients of France on 30 patients published in 2007[19]	Mean age in overlap group was 58 years

6. Limitations of this study

1. This is an observational study i.e. conclusions that are drawn are merely results of observations.
2. Confounding parameters of OSA were not dealt with in depth as it was beyond the scope of the study. And sleep parameters like stages of sleep were not compared with age matched population.
3. Due to resource limited setup we could not go into the details of risk factors in patients of OSA and put forward only the observations.
4. Large, long term, prospective, randomized controlled studies are necessary to more fully evaluate CPAP and asthma outcomes.
5. Large, long term, prospective, randomized controlled studies are necessary to study sleep pattern changes among obstructive airway disease patients, to study the effect of CPAP on sleep architecture.

6.1. Strength of this study

COPD and asthma remains a major public health problem and has considerable morbidity and mortality. Prevalence of OSA and overlap syndrome is also on a rise. These diseases were affecting quality of sleep and hence quality of life. In the present study, polysomnography was used to find sleep disturbance and OSA in study population. Polysomnography was also used to find out correlation between OSA and patients having COPD and asthma in resource limited settings. Use of auto-CPAP was found to be effective in OSA patients.

7. Conclusions

From this study, we may conclude that risk factors that were observed in patients having OSA were age more than 45, male sex, obesity, smoking, nasal polyp. 19 (73.08%) patients (out of 26 OSA patients) had mild to severe obesity suggesting that obesity is risk factor for the development of obstructive sleep apnea in the present study. In patients with overlap syndrome had more severe hypercapnia (mean $PaCO_2$ 48.88 $\pm$0.017), and nocturnal desaturation (mean 85.35% $\pm$0.022) Patients having moderate COPD had severe OSA. Patients having severe asthma had severe OSA with correlation coefficient R = -0.527 with p value <0.001 meaning negative linear correlation between AHI and %FEV1 of predicted of Asthma patients.

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10. Conflict of Interest

The authors declare they have no conflict of interest.

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