

Original Research Article

## Obstructive sleep apnea (OSA) with Type 2 Respiratory Failure in Chronic Obstructive Pulmonary Disease (COPD) patients

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**Abstract:** Patients with the overlap syndrome typically experience more pronounced nocturnal oxygen desaturation and have a high prevalence of pulmonary hypertension, which further predisposes to respiratory failure. The aim of this study was done to find out prevalence of OSA with Type 2 Respiratory Failure in COPD patients and additional objective was to find any diurnal variation in BGA among subjects. The present prospective study was carried out in the Department of Pulmonary and Critical Care Medicine, Pt. B. D. Sharma PGIMS Rohtak for a period of 20 months i.e. during July 2012 to February 2014. Patients seeking care and diagnosed with COPD formed the study population. COPD patients stable for at least six weeks were included in this study. Mild COPD patients, IHD patients, any co-morbid state, known case of OSA and patients having COPD with acute exacerbation were excluded. Polysomnography was done using Somnologica studio 3.3.2 Embla N7000 sleep unit system. Blood gas analysis was done in all patients in morning and evening. Prevalence of Overlap Syndrome with Type 2 Respiratory Failure in patients of COPD was found to be 12.5% (5 out of 40 subjects). PCO<sub>2</sub> and HCO<sub>3</sub> varied significantly among cases and controls when BGA analysis done in the morning and evening. pH also varied significantly among cases and controls in the morning samples. O<sub>2</sub> saturation significantly varied on morning – evening time blood gas analysis among cases. Prevalence of Overlap Syndrome with Type 2 Respiratory Failure in patients of COPD was found to be in the higher range in North Indian population. pCO<sub>2</sub> and HCO<sub>3</sub> varied significantly among cases and controls when BGA analysis done in the morning and evening. O<sub>2</sub> saturation significantly varied on morning – evening time blood gas analysis among cases.

**Keywords:** Prevalence, Chronic Obstructive Pulmonary Disease, Acute exacerbation of COPD, obstructive sleep apnea syndrome, Type 2 Respiratory Failure.

### INTRODUCTION

Respiratory failure is a syndrome in which the respiratory system fails in one or both of its gas exchange functions: oxygenation and carbon dioxide elimination. In practice, it may be classified as either hypoxemic or hypercapnic. Hypercapnic respiratory failure (type II) is characterized by a PaCO<sub>2</sub> higher than 50 mm Hg [1]. The pH depends on the level of bicarbonate, which in turn is dependent upon the duration of hypercapnia [2]. Common etiologies include drug overdose, neuromuscular diseases, chest wall abnormalities, and severe airway disorders (eg: asthma and chronic obstructive pulmonary disease [COPD]) [3].

Patients having OSA along with COPD are termed “overlap syndrome” The incidence of COPD in patients with OSA has been estimated by various authors as 9% to 29% [4, 5]. The coexistence of asymptomatic COPD and OSA is likely much higher [6]. Patients with both COPD and OSA have two reasons to have nocturnal oxygen desaturation, and the Sleep Heart Health Study did find that those with both OSA and COPD are at greater risk of prolonged oxygen desaturation at night than those with OSA but without COPD. The degree of obstruction, as measured by FEV<sub>1</sub>/FVC, correlates with the risk of prolonged hypoxemia.<sup>5</sup>This coexistence of COPD appears to increase morbidity and mortality in OSA.

Various studies have reported that 27-70% of patients with COPD with awake oxygen saturation of 90-95% can experience substantial desaturation at night, particularly during REM sleep [6, 7]. Patients with the overlap syndrome typically experience more pronounced nocturnal oxygen desaturation and have a high prevalence of pulmonary hypertension, which further predisposes to respiratory failure. Hence this study was done to find out prevalence of OSA with Type 2 Respiratory Failure in COPD patients and additional objective was to find any diurnal variation in BGA among subjects.

## MATERIALS AND METHODS

The present cross-sectional study was carried out in the Department of Pulmonary and Critical Care Medicine, Pt. B. D. Sharma PGIMS Rohtak for a period of 20 months i.e. during July 2012 to February 2014. Patients seeking care at the Department of Pulmonary and Critical Care Medicine and diagnosed with COPD formed the study population. COPD patients stable for at least six weeks were included in this study. Mild COPD patients, IHD patients, any co-morbid state, known case of OSA and patients having COPD with acute exacerbation were excluded.

Pt. B. D. Sharma PGIMS Rohtak is a tertiary care teaching hospital equipped with ultra-modern multi super specialty facilities and apex referral unit of Haryana state. The hospital receives major chunk of its patients not only from Haryana but also from neighboring states especially Rajasthan, Punjab, Delhi and Uttar Pradesh. Thus this tertiary care hospital provided us a perfect base to study such an objective.

Purposive sampling technique was adopted. A total of 59 patients were enrolled in this study but at the end 40 cases and 10 controls were selected following below mentioned algorithm. COPD was diagnosed as per standard guidelines i.e. global initiative for obstructive lung disease (GOLD) guidelines [8].

40 patients of chronic stable COPD - stable for at least six weeks and 10 controls (age and sex matched) fulfilling their respective inclusion and exclusion criteria was included in the study. Study group consisted of Chronic stable COPD patients - 20 patients of Moderate COPD and 20 patients of Severe

and Very Severe COPD (as per GOLD staging), without any other co-morbidities. Control group consisted of Healthy individuals, age and sex matched without any systemic illness and OSA.

Study participants were subjected to detailed history taking including smoking habits, alcohol consumption, routine blood investigations, chest radiography, and echocardiography to rule out left ventricular failure and underwent anthropometry measurements & ENT examination. Spirometry was carried out on the study participants and parameters recorded were forced expiratory volume in the first second (FEV<sub>1</sub>) in liters, forced vital capacity (FVC) in liters and FEV<sub>1</sub>/FVC% (FEV<sub>1</sub>/FVC). Polysomnography was done using Somnologica studio 3.3.2 Embla N7000 sleep unit system (2005) in all the patients, selected for the study.

The study adhered to the tenets of the Declaration of Helsinki for research in humans. Informed consent was obtained from study subjects after discussing advantages and risks. Permission of Institutional ethics committee (IEC) was sought before the commencement of the study. All the questionnaires along with other relevant data were manually checked and were then coded for computer entry. After compilation of the collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 20 (IBM, Chicago, USA). The results were expressed using appropriate statistical methods. Student t-test was used to test level of significance. A two tailed  $p < 0.05$  was considered statistically significant.

## RESULTS

Prevalence of Overlap Syndrome with Type 2 Respiratory Failure in patients of COPD was found to be 12.5% (5 out of 40 subjects). Blood gas analysis was done in all patients in morning and evening. pCO<sub>2</sub> and HCO<sub>3</sub> varied significantly among cases and controls when BGA analysis done in the morning and evening. pH also varied significantly among cases and controls in the morning samples. (Table 1)

On comparing morning – evening time blood gas analysis among cases, variations in O<sub>2</sub> saturation were found to be statistically significant.

**Table 1: Comparison of morning time blood gas analysis between cases and controls**

BGA parameters	Cases N=5		Control N=10		P value
	Mean	Std. Deviation	Mean	Std. Deviation	
<b>Comparison of morning time blood gas analysis between 2 groups</b>					
pO <sub>2</sub> (mm Hg)	49.78	10.92	76.13	13.51	0.72
pCO <sub>2</sub> (mm Hg)	58.56	12.36	39.09	1.04	<0.001
Ph	7.37	0.05	7.39	0.02	0.02
HCO <sub>3</sub> (meq/l)	33.00	6.09	24.45	0.91	<0.001
O <sub>2</sub> saturation (%)	76.84	2.16	94.53	2.19	<0.001

Comparison of evening time blood gas analysis between 2 groups					
pO <sub>2</sub> (mm Hg)	46.64	11.67	75.76	11.92	<0.001
pCO <sub>2</sub> (mm Hg)	59.10	8.90	40.17	2.79	0.004
pH	7.36	0.03	7.39	0.03	0.91
HCO <sub>3</sub> (meq/l)	33.06	6.95	24.58	0.95	<0.001
O <sub>2</sub> saturation (%)	73.72	7.31	92.31	4.70	0.25
Two-Sample Independent t Test, p-value (two-tailed)					

Table 2: Comparison of morning – evening time blood gas analysis among cases

BGA parameters	Morning		Evening		P value
	Mean	Std. Deviation	Mean	Std. Deviation	
pO <sub>2</sub> (mm Hg)	49.78	10.92	46.64	11.67	0.90
pCO <sub>2</sub> (mm Hg)	58.56	12.36	59.10	8.90	0.54
pH	7.37	0.05	7.36	0.03	0.35
HCO <sub>3</sub> (meq/l)	33.00	6.09	33.06	6.95	0.80
O <sub>2</sub> saturation (%)	76.84	2.16	73.72	7.31	0.03
p-value (two-tailed)					

## DISCUSSION

Patients with overlap syndrome have several mechanical disadvantages to breathing during sleep. Apart from upper and lower airway obstruction, a reduction in respiratory drive and functional residual capacity [9]. These patients also have respiratory muscles fatigue. It has also been shown that these patients are at a greater risk of prolonged oxygen desaturation [10]. It implies that overlap syndrome is important from the point of view of aggravating the effects of both the disorders. Also, it is known that obese patients are more likely to present with type II respiratory failure; it is not known that they may suffer from OSAS [11].

In this study we observed that out of 40 subjects, 5 patients were having respiratory failure along with COPD and OSA. Morning – Evening blood gas analysis was done in all patients. There was statistically significant difference in pCO<sub>2</sub>, pH, and bicarbonate and O<sub>2</sub> saturation between the two groups. Another study from Northern Indian tertiary care hospital concluded that respiratory failure was more common in patients with overlap syndrome [12]. It concluded that patients with Overlap syndromes are more likely to have respiratory failure as compared to patients having only acute exacerbation of COPD. AECOPD have a high prevalence of OSAS.

David Hiestand *et al.*; concluded in his investigation that individuals who have the overlap syndrome have been recognized to have greater risk for pulmonary hypertension, right heart failure, and hypercapnia than patients who have either disorder alone [13].

Another study from Hopitaux Universities de Strasbourg, France [14] is also in concordance with our observations. That study revealed that patients with

overlap syndrome have a more important sleep-related O<sub>2</sub> desaturation than patients with COPD alone with the same degree of bronchial obstruction. They have an increased risk of developing hypercapnic respiratory insufficiency and pulmonary hypertension when compared with patients with SAHS alone.

Marin *et al.*; also evaluated exacerbation with respect to overlap syndrome [15]. It was a longitudinal study with more than 200 patients in three arms consisting of only COPD, overlap treated with continuous positive airway pressure (CPAP) and overlap not treated with CPAP. The study revealed that overlap syndrome not treated with CPAP have a higher mortality i.e. death from any cause ranging from cardiovascular, cancer to pulmonary compared to only COPD. It was also shown that the overlap syndrome patients who were not treated with CPAP are likely to suffer COPD exacerbation requiring hospitalization compared to only COPD. The severity of exacerbation in patients with only COPD, however, was not compared to overlap syndrome not treated with CPAP.

This study has several strengths. First, to our knowledge, assessment of burden of OSA with Type 2 Respiratory Failure in COPD patients has not been investigated much in India. Very few studies are available in the literature on this topic. Second, we also studied diurnal variation in BGA among subjects. This aspect has not been investigated till date from India. This is one of the reasons we could not find studies to compare with our findings. Third, all the cases were tackled by a single person, which created a sense of uniformity in data gathering. Small sample size is an evident limitation of this study. Association of obesity and metabolic syndrome with OSA with Type 2 Respiratory Failure in patients of COPD was not done in this study.

## CONCLUSION

Prevalence of Overlap Syndrome (OSA) with Type 2 Respiratory Failure in patients of COPD was found to be in the higher range in North Indian population. The findings of the study highlight that pCO<sub>2</sub> and HCO<sub>3</sub> varied significantly among cases and controls when BGA analysis was done in the morning and evening. O<sub>2</sub> saturation significantly varied on morning – evening time blood gas analysis among cases. Data thus generated can be used to plan and provide care to Overlap Syndrome (OSA) with Type 2 Respiratory Failure in patients of COPD.

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