

Comparative Study of Sleep Apnoea Inchronic Bronchitis and Emphysema

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Abstract: Sleep apnoea have been observed in Chronic Obstructive Pulmonary Disease (COPD), butthere seems to be a dearth in the knowledge correlating the occurrence of sleep disorders in different stages of COPD. Studies in the Indian scenario are staggeringly low. Indian studies done previously, could not throw light on the association of sleep disorders with the severity of airway obstruction. The knowledge might prove useful to foresee the sleep disturbances with each stage of COPD, with the consequent therapeutic implications.this study to detect sleep disordered breathing in patients with chronic bronchitis and emphysema, to correlate sleep disordered breathing with the stages of disease, in patients with COPD and to find out prevalence of overlap syndrome. The present study was a cross-sectional study. The study was carried out in the sleep laboratory of SreeBalaji Medical College and Hospital, A total of 36 COPD patients were enrolled into the study. Results revealed that among 36 patients two had OSA. The prevalence of OSA among patients with COPD was 5.55%. No significant correlation was found to exist between AHI and FEV1 In conclusions,the prevalence of overlap syndrome is 5.55%. Body mass index (BMI) and neck circumference is found to be the significant factor that contributes to increased Apnoea Hypopnea Index (AHI) in COPD patients.AHI is more in chronic bronchitis compared to emphysema probably because of the low BMI in emphysema patients.Pulmonary functions might not predict the occurrence of Obstructive Sleep Apnoea in COPD.

Key words: Polysomnography • Chronic Obstructive Pulmonary Disease • Obstructive Sleep Apnea • Overlap Syndrome • Chronic Bronchitis • Emphysema

INTRODUCTION

Origin of Sleep Medicine: Mankind has been fascinated by the mysteries of sleep since the dawn of history. Unraveling the secrets of sleep was a daunting and tedious task and sleep researchers have made remarkable strides in demystifying sleep. Two thousand years ago, Lucretius defined Sleep as the absence of wakefulness. The first sentence of the 'Philosophy of Sleep', a book by MacNach in 1834, proclaimed that Sleep is the intermediate state between wakefulness and death, exemplifying the Passive nature of sleep [1]. It took more than a century for demolishing this scientific dogma; in 1989, J. Allan Hobson, in the opening statement of his book 'sleep' emphasized that sleep is a dynamic behaviour, not simply the absence of waking, sleep is a special activity of the brain, controlled by elaborate and precise mechanisms [2].

After the successful demonstration of electrical activity of human brain in 1928 by German Psychiatrist, Hans Berger [3], who termed these electrical signals as 'electroencephalograms' (EEG), for the first time, the presence of sleep could be conclusively established and quantitatively measured without disturbing the sleeper. Subsequent to the discovery of Rapid Eye Movement (REM) sleep in 1950s by Aserinsky and Kleitman[4], the basic sleep cycle was described by Dement and Kleitman [5]. Sleep Medicine thus became a science.

Sleep definition: Sleep is defined as a period of bodily rest characterized by reduced awareness of the environment, a species specific posture and for most species, a particular sleep place [6].

Two separate states, non rapid eye movement (NREM) and rapid eye movements (REM) have been defined on the basis of a constellation of physiological parameters. NREM sleep is conventionally subdivided

into four stages, which are relatively based on EEG recordings, representing the continuum of deepening sleep. REM sleep, by contrast, is defined by EEG activation, muscle atonia and episodic bursts of rapid eye movements [7].

The Physiology of different organ systems of the body is altered during sleep. Sleep is associated with definite alterations in the respiratory function in the normal human beings. Hypoventilation, periodic breathing and erratic, shallow breathing with the resultant hypoxemia is observed in different states of sleep, the ventilatory changes being within physiological limits [8, 9]. The respiratory alterations become pronounced and pathological in different respiratory ailments, especially Chronic Obstructive Pulmonary Disease (COPD).

Chronic Obstructive Pulmonary Disease (COPD): COPD is recognized as a cause of significant morbidity and mortality, tantalizing the World all over. According to GOLD guidelines, 2011, COPD is defined as “a preventable and treatable disease characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases”.

Sleep Disorders in COPD: All patients with COPD become more hypoxemic during sleep than during restful wakefulness [10-12]. The drop in oxygen saturation during sleeping is more than during exercise and because patients of COPD spend much more time in sleeping than exercising, sleep is a more significant cause of hypoxemic load for these patients [13]. It has been found that COPD patients have poor sleep. Insomnia is a very common complaint. 17% of COPD patients complain of insomnia, which is third most common complaint in these patients [14].

The dual occurrence of Obstructive sleep apnea (OSA) in COPD is termed as ‘Overlap syndrome’ by Flenley [15] which is recognized for causing lethal effects on the patient’s haemodynamics. Different studies reflect conflicting prevalence of overlap syndrome, ranging from 2% - 28% [16-19]. Significant sleep desaturation and the sleep disturbances are greater in overlap syndrome than OSA alone and these patients are particularly prone to complications of chronic hypoxemia such as pulmonary hypertension, cor pulmonale and polycythemia [20, 21].

Hypoxemia during sleep in patients with COPD has significant cardiovascular, neurophysiological and hematological consequences. Cardiac dysrhythmias, polycythemia, pulmonary and systemic hypertension, cor pulmonale are known to occur with increased

precedence culminating into nocturnal death [22, 23]. Thus sleep disorders in COPD patients cause incipient and often unforeseen havoc and is a matter of deep concern and conflict.

Most of the research in sleep done so far is from the West. In a Tropical country like India, with the different climatic and socio-economic conditions, vividly multifarious smoking habits and above different health-care infrastructure, these studies might not have relevance. There seems to be a dearth in the knowledge correlating the occurrence of sleep disorders in different stages of COPD. Studies in the Indian scenario are staggeringly low. Indian studies done previously, could not throw light on the association of sleep disorders with the severity of airway obstruction. The knowledge might prove useful to foresee the sleep disturbances with each stage of COPD, with the consequent therapeutic implications.

In recognition of the importance, the present study is conducted in SreeBalaji Medical College and Hospital, Chennai, to find the association between sleep disorders in patients with COPD.

Purpose:

- To detect sleep disordered breathing in patients with chronic bronchitis and emphysema.
- To correlate sleep disordered breathing with the stages of disease, in patients with COPD.
- Prevalence of overlap syndrome.

Materials: The present study, “Correlates of sleep disorders in COPD patients”, was carried out in the sleep laboratory of SreeBalaji Medical College and Hospital, Chennai; with an aim to evaluate the sleep disorders in COPD patients and to correlate these disorders with the stage of COPD

Study Design: The present study was a cross-sectional study.

Study Period: The study is carried from August, 2011 to April, 2012.

Sample Size: A total of 36 COPD patients were enrolled into the study.

Inclusion criteria:

- Clinical history consistent with COPD
- FEV1/FVC < 70% predicted

- Irreversible airflow obstruction (post-bronchodilator change in FEV1<15% or <200ml.

Exclusion criteria:

- Patients with active Tuberculosis or other respiratory diseases
- Patients with congestive heart failure or chronic renal failure
- Patients with active infections
- Patients with severe obesity (BMI= 40)
- Pregnant women

Consent: An informed written consent was taken from all the patients enrolled in the study after a proper health education.

Methods: A total number of 36 consecutive COPD patients were enrolled into the study. Detailed history consisting of the smoking habits, duration and present status was taken. Complete physical examination and all relevant laboratory investigations were done as per the protocol. These patients were classified into chronic bronchitis and emphysema according to clinical and radiological picture. These patients were further classified into mild, moderate, severe and very severe COPD groups in accordance to GOLD guidelines.

GOLD STAGING OF COPD

Gold Stage	Severity	Spirometry
I	MILD	FEV1/FVC < 0.7 and FEV1 > 80% Predicted
II	MODERATE	FEV1/FVC < 0.7 and 50% < FEV1 < 80% Predicted
III	SEVERE	FEV1/FVC < 0.7 and 30% < FEV1 < 50% Predicted
IV	VERY SEVERE	FEV1/FVC < 0.7 FEV1 < 30% predicted (or) FEV1 50% predicted plus chronic respiratory failure

The 36 patients underwent anthropometry in which weight and height are measured and the BMI was calculated based on the formula

$$\text{BMI} = \text{weight in Kg}/(\text{height in m})^2$$

Neck circumference (cm) was measured at the level of crico-thyroid membrane.

The complete procedure of polysomnography study was explained to each patient and these patients were subjected to a full night sleep study (overnight polysomnography). The software used is Recorders & Medicare India 16 channel polysomnographyholter. The electrode and sensor connection system utilizes E-series EEG/PSG system in order to record the PSG study.

The polysomnographic study was started at a time, which coincides with the normal sleeping habits of the patient. A total of 16 leads were used in the sleep study. The procedure followed for the placement of electrodes was as follows:

Reference and Ground Electrodes: Patients were connected to reference electrodes first. This allows input signal to be correctly referenced before attempting to view patients traces. The REF electrode was placed over the central portion of forehead. The next electrode placed is ground, the driven electrode, which was usually placed near A1/A2.

EOG Electrodes: LOC (Left oculogram)connected 1 cm lateral and below left eye outer canthus and to input socket 22 on the patient interface box. ROC (Right oculogram)connected 1cm lateral and above right eye outer canthus and to input socket 23 on the patient interface box.

EEG Electrodes: Four electrodes C3, C4, A1 and A2 measures the electroencephalographic impulses. C3 and C4, the cortical leads were placed in accordance to international 10-20 nomenclature for EEG electrode placement.

A1 electrode was placed over left mastoid process, whereas A2 placed over right mastoid process.

ECG Electrodes: Two electrodes were connected for ECG signal. One electrode on mid clavicular line on each side and were connected to the respective channels on patient interface box.

EMG Electrodes: The submental EMG electrodes were connected under the chin separated by approximately 3 cm.

LEG Sensors: Using adhesive patient tape leg sensors were attached over the bulk of the left and right leg tibialis anterior muscle, respectively were greatest movement occurs.

Airflow Sensors: Airflow sensors was attached to patients upper lip, so that the three thermocouple beads are exposed to the patients nasal and oral airflow.

Respiratory and Abdominal Bands: Bands was attached around patients chest and abdomen, making sure that the band is attached firmly but not restrictive or uncomfortable for the patient.

Microphone: Microphone was attached to patients throat using adhesive tape to sense snoring.

Oximeter Probe: A 10 x 2.5 cm tape was applied to the oximeter probe which is attached to finger with sensors aligned on palm side of finger.

After ensuring all leads were working properly, the lights were switched off and the study was started. The study was closely watched throughout and any displacement of the electrodes was immediately corrected and the relevant notes put in the computer. All the needs of the patient when required were swiftly attended to. The study was stopped the next morning after the patient woke up voluntarily.

APNOEA: Temporary absence or cessation of respiration. There are types of Apnoea:

- Obstructive- absence of airflow but continued respiratory effort
- Central- absence of airflow and respiratory effort
- Mixed- starts as a central event and then becomes obstructive during the latter portion of the same episode.

HYPOPNOEA: Defined as a decrement in airflow of 50% or more associated with a 4 percentage fall in Oxygen saturation and/or EEG arousal. The event lasts 10 seconds or longer.

Nocturnal Oxygen Desaturation: Defined as total recording time with a Oxygen saturation of <90% or nocturnal Oxygen saturation < 85% for atleast 5 minutes. **SLEEP DISORDERED BREATHING:** Repetitive episodes of apnoea or hypopnoea during sleep associated with sleep fragmentation, arousals and reduction in Oxygen saturation.

Apnoea Hypopnoea Index: The number of apneas plus hypopnoeas per hour of sleep. It is the standard metric used to quantitate the severity of obstructive sleep apnoea. An AHI > 5-10 events per hour is indicative of OSA.

Obstructive Sleep Apnoea Syndrome (OSAS): OSAS must fulfill the following criteria - A/B +C

A- Two or more of the following that are not explained by other factors

- Choking or gasping during sleep
- Recurrent awakenings from sleep
- Unrefreshing sleep
- Daytime fatigue
- Impaired concentration

Overnight monitoring demonstrates 5 to 10 or more obstructive breathing events per hour during sleep / greater than 30 events per 6 hrs of sleep.

Interpretation: Personal details and characteristics of study population: COPD is a disease of the elderly population. The mean age of the study group in the present study is 57.72, which is in concordance with the prevalence rates of the disease in different parts of the world. Most of the patients enrolled into our study are males (M:F :: 35:1). This uneven distribution might be due to multifarious reasons-the pattern of flow of the patients during the period of the study, refusal of the female patients to consent for the sleep study etc.

Among the 36 patients, 20 (55.55%) and 16 (44.44%) belonged to emphysema and chronic bronchitis respectively. The mean smoking index of the study group was 24.78 pack years.

A significant negative correlation between smoking and BMI was found. As the smoking pack years increases BMI is decreasing. A similar finding has been given in another Indian study[24] where smoking is strongly associated with low BMI. A significant positive correlation between FEV1 and BMI was found. As FEV1 decreases BMI decreases (R= 0.332). The least mean BMI was found in the stage IV COPD patients. This suggests a poor nutritional status with chronicity and severity of COPD.

The mean BMI and the neck circumference of the study group were 22.78 and 35.37 respectively. Among the 36 subjects, 8(22.22%) have BMI> 24.9. All of them belong to class I obesity [25]. Out of the 8 patients, 6 and 2 patients belonged to chronic bronchitis and emphysema group respectively. Among the 8 obese subjects 2 (25%) have OSA. Both the patients belonged to chronic bronchitis group. Obesity remains one of the main risk factors for Obstructive Sleep Apnoea. Previous studies have shown that incidence of OSA in obese populations ranges from 40% [26] to 93% [27]. A very significant positive correlation between BMI, neck circumference and

AHI was noticed in our study. As the BMI increases, neck circumference and AHI increases ($R=0.847$ and 0.677 respectively).

Subgroup analysis of the COPD patients revealed that 1 patient belonged to mild (16.6%), 1 patient in moderate COPD (12.5%) and 3 patients (37.5%) belonged to very severe COPD. Both the patients belonging to mild and moderate stages were having concomitant high BMI and OSA whereas the patients in very severe COPD didn't have a similar finding.

Overlap Syndrome: In our study, out of 36 subjects, 2 (5.55%) had overlap syndrome. These two patients belonged to chronic bronchitis group. This can be because of low BMI in emphysema compared to chronic bronchitis group. Various authors studied the occurrence of OSA in COPD patients. Earlier studies by Resta O *et al* and de Miguel J *et al* have documented OSA in 16% and 28.5% of COPD patients respectively [28, 29]. These studies had a selection bias as they included patients from sleep clinics. These patients had excessive day time somnolence as one of the chief complaints and moreover these patients were obese. Another study showed that Overlap syndrome has a prevalence of 14% among patients with mild COPD [30]. Our patients were enrolled from chest clinics with primary respiratory symptoms and their BMI was not high. The study conducted by SK Sharma *et al* in an Indian scenario has quoted a 6% occurrence of OSA in COPD patients with most of the patients having significantly severe disease at the time of enrolment [31]. They proposed that BMI per se is responsible for AHI with, Neck circumference having a small contribution. But our study has shown that both BMI and neck circumference has a significant positive correlation with AHI. No significant correlation was found to exist between AHI and FEV1 in our study. A community-based study, showed that sleep structure variables did not change in subjects with a history of lung disease [32].

It can be finally concluded that pulmonary functions do not predict the occurrence of sleep apnoea in COPD and only BMI and Neck circumference per se contributes to the raised AHI in COPD patients.

CONCLUSION

Sleep may be associated with serious and potentially life-threatening respiratory disturbances in COPD, yet many physicians pay little attention to this aspect of the disorder.

After the statistical analysis of the result obtained in the study, following conclusions are drawn.

- The prevalence of overlap syndrome is 5.55%.
- BMI and neck circumference is found to be the significant factor that contributes to increased AHI in COPD patients.
- AHI is more in chronic bronchitis compared to emphysema probably because of the low BMI in emphysema patients.
- Pulmonary functions might not predict the occurrence of OSA in COPD

It is now recognised that appropriate therapy with oxygen and selected therapies can substantially improve the sleep quality with consequent benefit to daytime performance.

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