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Original Research Article

Study of sleep patterns in asthma and COPD diseases at tertiary care hospital in India

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ABSTRACT

Background: Sleep is the natural periodic suspension of consciousness during which the powers of the body are recovered. It is a natural periodic state of rest for the mind and body, in which the eyes usually close and consciousness is completely or partially lost so that there is a decrease in bodily movement and responsiveness to external stimuli. Present study was planned to study the sleep patterns in various respiratory diseases at Tertiary care Hospital in India.

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: Total sleep time appears to be decreased in COPD patients with mean value of 284.3 (\pm 43.02) minutes, with decreased sleep efficiency of 66.64 % (\pm 0.074). Study group patients have frequent awakenings with average of 17.73 (\pm 6.15). They have decreased slow wave sleep (S3 and S4 stages) with mean value for S3 is 2.81% (\pm 0.68) and for S4 is 6.45% (\pm 1.64). The mean value for REM sleep in these patients is 12.42% (\pm 2.72) and that for S1 and S2 is 13.99% (\pm 4.84) and 64.62% (\pm 4.72) respectively. Total sleep time appears to be decreased in asthmatic patients with mean value of 299.89 (\pm 45.17) minutes, with decreased sleep efficiency of 68.38% (\pm 0.065). Study group patients have frequent awakenings with average of 21.03% (\pm 7.44).

Conclusions: In patients with Asthma & COPD, polysomnography study suggests poor sleep quality characterized by decreased total sleep time, decreased sleep efficiency, frequent awakenings, altered sleep architecture with decreased slow wave sleep and REM sleep.

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1. Introduction

Sleep is the natural periodic suspension of consciousness during which the powers of the body are recovered.¹ It is a natural periodic state of rest for the mind and body, in which the eyes usually close and consciousness is completely or partially lost so that there is a decrease in bodily movement and responsiveness to external stimuli.² It is the intermediate state between wakefulness and death; wakefulness being regarded as the active state of all the

animals and intellectual functions, and death as that of their total suspension.³ Unlike coma sleep is reversible. Sleep has been shown in recent past years to play a vital role in the health of human beings.

Sleep is divided into two discrete types: rapid eye movement (REM) sleep and non-rapid eye movement (NREM) sleep. In a sleep laboratory REM and NREM are distinguished by the use of electroencephalography (EEG), electromyography (EMG), electrooculography (EOG), and visual observation.⁴⁻⁶ REM sleep and NREM sleep are different in several aspects. REM sleep can be characterized

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best as an active brain in a quiet body, whereas NREM sleep quiet brain in an active body. Heart rate, blood pressure, respiratory rate, ventilator drive and temperature are stable in NREM sleep. In REM sleep, most physiologic variables are more unstable than in either the waking or NREM sleep. In addition, there is an upper motor neuron paralysis during REM sleep that results in the inability to perform sustained purposeful movement. Teleologically, this prevents us from acting out our dreams.^{4,5}

Humans typically enter sleep through NREM, progress through stages 1 through 4, and experience the first bout of REM sleep about 90 minutes after sleep onset. As sleep time progresses more time is spent in REM sleep. Normal sleep is about 75% NREM and 25% REM. At either extreme of life, nocturnal sleep is more fragmented and napping is more likely to occur. The percentage is probably highest at birth and decreases over the course of a lifetime.^{4,5}

Humans probably need and tend to average 7 or 8 hours sleep within a 24 hour period. There are many determinants of sleepiness and sleep need, including previous sleep, time of day, genetics, individual characteristics, medications, and disease, including intrinsic sleep disorders and many medical conditions. Age and sex also play a role.⁴ Sleep regulation is dependent upon circadian rhythm and homeostatic drives. Circadian rhythm is organized through the suprachiasmatic nucleus, for which environment light is the dominant influence. REM sleep, in particular has a circadian rhythm with peak pressure in the early morning hours (which corresponds to the 24 hour trough in body temperature). Homeostatic pressure increases the longer one is awake and decreases the longer one is asleep. A simplified way of looking at sleep control is that homeostatic pressure makes us fall asleep, but circadian pressure (which peaks in the morning hours) keeps us asleep.^{4,5,7,8} With this view, present study was planned to study the sleep patterns in Asthma & diseases at Tertiary care Hospital in India.

2. Material 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. 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 years.
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.⁹

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

3. 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.

Total sleep time appears to be decreased in COPD patients with mean value of 284.3 (\pm 43.02) minutes, with decreased sleep efficiency of 66.64 % (\pm 0.074). Study group patients have frequent awakenings with average of 17.73 (\pm 6.15).

They have decreased slow wave sleep (S3 and S4 stages) with mean value for S3 is 2.81% (\pm 0.68) and for S4 is 6.45% (\pm 1.64). The mean value for REM sleep in these patients is 12.42% (\pm 2.72) and that for S1 and S2 is 13.99% (\pm 4.84) and 64.62% (\pm 4.72) respectively.

They have average nocturnal saturation of 94.10% (\pm 0.021) with average lowest nocturnal saturation of 90.67% (\pm 0.038).

Total sleep time appears to be decreased in asthmatic patients with mean value of 299.89 (\pm 45.17) minutes, with decreased sleep efficiency of 68.38% (\pm 0.065). Study group patients have frequent awakenings with average of 21.03% (\pm 7.44).

They have decreased slow wave sleep (S3 and S4 stages) with mean value for S3 is 2.68% (\pm 0.698) and for S4 is 6.77% (\pm 1.47). The mean value for REM sleep in these patients is 12.09% (\pm 3.49) and that for S1 and S2 is 14.97% (\pm 4.43) and 63.49% (\pm 4.99) respectively.

They have average nocturnal saturation of 95.90% (\pm 0.014) with average lowest nocturnal saturation of 92.35% (\pm 0.026).

4. Discussion

All the patients included in the study were subjected to detail history, physical examination, basic and specific investigations. For the purpose of meticulous data collection a proforma was prepared and filled for every patient. Collected data was entered regularly in the MS EXCEL 2007 sheet and then analyzed. Observations and results were compared with other similar studies done in India and across the world. Obesity, a risk factor for OSA has reached epidemic proportions in India and rest of the world in 21st century. COPD and bronchial asthma are common clinical problems. COPD is currently the fourth leading cause of death worldwide.⁹

Prevalence of overlap syndrome that is association of COPD and OSA and bronchial asthma patients having OSA is also on rise and we intended to study it along with the risk factors responsible in the present study population. In the present study, patients having COPD were more 67 (68.37%) than that of bronchial asthma 31 (31.63%).

In study done by Khalil et al., on “Sleep quality among patients with COPD at a university hospital in Egypt” on 60 patients of COPD in the year 2019 found that Most of the patients were married males, their age ranged between 50 and 69 years with a mean age of 61 and one-third of them were smokers. The majority of patients (80%) had the unsatisfactory level of sleep according to Pittsburgh Sleep Quality Index. The factors altered the patients’ sleep included physiological factors such as the production of sputum and chest tightness. The most influential environmental factors included the movement of health care members, performing nursing procedures and administration of nebulizer sessions. The dietary factors included hunger. The influential psychological factors included patients’ anxiety and fear of being alone. Finally, daily life habits as daytime naps and smoking.¹⁰

Malhotra et al., in their article concluded that polysomnographic features in COPD are a consequence of sleep-induced respiratory loads. Patients with COPD may respond to increased respiratory loads with marked sleep disturbances or, alternatively, they may have minimal sleep disturbance but a highly abnormal breathing pattern with or without severe alterations in gas exchange. The same principles described in this statement for COPD may also apply to other respiratory diseases characterized by lower airway obstruction, such as asthma and cystic fibrosis. Depending on which polysomnographic features predominate, patients may present with a variety of daytime symptoms and clinical outcomes, ranging from insomnia to hypersomnia with and without cardiopulmonary complications.¹¹

In review article of McNichola concluded that patients with COPD are subject to a range of sleep-related abnormalities that include poor sleep quality and sleep disordered breathing with associated hypoxaemia.¹²

In 45 patients, Ashour et al., studied sleep pattern changes in COPD, and found that there is significant change in sleep pattern between mild to moderate COPD patients and normal individuals.¹³

In review article of Budhiraja et al., concluded that COPD is frequently associated with sleep-related abnormalities as well as primary sleep disorders. Presence of these comorbidities may worsen the already diminished quality of life in COPD patients and increase the odds of several other adverse health outcomes including higher mortality. A regular inquiry by health providers to COPD patients regarding sleep and potential sleep disorders, followed by management as warranted, may have the potential of ameliorating these risks and improving the quality of life and survival.¹⁴

Cukics et al., and Luyster et al., mentioned in their article that insomnia and poor sleep is highly prevalent in asthma and increases with severity.^{15,16}

Table 1: Showing characteristics of sleep in patients with COPD

Sleep variables	Mean (Standard Deviation)	Range
Total sleep time (TST) in minutes	284.3 (± 43.07)	179.6 - 399.5
Sleep efficiency %	66.64 % (± 0.074)	49.10% - 82.90%
Number of awakenings	17.73 (± 6.15)	7-37
S1 sleep % of TST	13.99% (± 4.84)	5.2% - 23.3%
S2 sleep % of TST	64.62% (± 4.72)	55.7% - 75.2%
S3 sleep % of TST	2.81% (± 0.68)	1.2% - 5.1%
S4 sleep % of TST	6.45% (± 1.64)	3.2% - 10.2%
REM sleep % of TST	12.42% (± 2.72)	7.9% - 17.2%
Average nocturnal saturation ANS %	94.10% (± 0.021)	89% - 97%
Lowest nocturnal saturation LNS %	90.67% (± 0.038)	82% - 95%

Table 2: Showing characteristics of sleep in asthmatic patients

Sleep variables	Mean	Range
Total sleep time (TST) in minutes	299.89 (± 45.17)	209.6 - 401.9
Sleep efficiency	68.38% (± 0.065)	53.50% - 83.20%
Number of awakenings	21.03% (± 7.44)	7% - 33%
S1 sleep % of TST	14.97% (± 4.43)	6.2% - 20.4%
S2 sleep % of TST	63.49% (± 4.99)	54.9% - 70.9%
S3 sleep % of TST	2.68% (± 0.698)	1.2% - 5.1%
S4 sleep % of TST	6.77% (± 1.47)	4.4% - 10.2%
REM sleep % of TST	12.09% (± 3.49)	4.1% - 16.2%
Average nocturnal saturation ANS %	95.90% (± 0.014)	92% - 98%
Lowest nocturnal saturation LNS %	92.35% (± 0.026)	84% - 95%

Sleep self-awareness and general knowledge appear insufficient in many studied cohorts, so increasing education about sleep for students might be beneficial. The knowledge of importance of sleep and consequences of sleep deprivation should be emphasized and translated into practice.¹⁷ We have come a long way in understanding and analyzing the clinical and metabolic consequences of sleep related disorders from the time first report of these by in early seventies.¹⁸

5. Limitations of present 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.

5.1. 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.

6. Conclusions

In patients with asthma and COPD, polysomnography study suggests poor sleep quality characterized by decreased total sleep time, decreased sleep efficiency, frequent awakenings, altered sleep architecture with decreased slow wave sleep and REM sleep.

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8. Source of Funding

None.

9. Conflict of Interest

The authors declare they have no conflict of interest.

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