ORIGINAL ARTICLE

Role of nocturnal oxygen therapy in interstitial lung disease with obstructive sleep apnoea syndrome

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ABSTRACT

Background: This study was conducted to demonstrate the effects of nocturnal oxygen therapy on patients of interstitial lung disease (ILD) with associated obstructive sleep apnoea syndrome (OSAS).

Methods: 12 patients (5 males, 7 females) of ILD with OSAS were included in the study. All patients had a restrictive abnormality on spirometry with a mean forced vital capacity (FVC) of 40 (+/- 14.22). The mean daytime pressures of oxygen in arterial blood (Pao2) were 71.88 (+/- 12.44) and that of carbon dioxide was 36.39 (+/- 8.27). 10 out of the 12 patients had a BMI of less then 25, while 2 patients had a BMI of 27 each. None of the patients had complaints of snoring or excessive daytime sleepiness. All patients were subjected to nighttime recording of respiratory variables (NTRRV). The first night study was done while breathing room air followed by a second night study supplemented with 2 litres of nasally administered oxygen. The effect of nasally administered oxygen on the apnoea- hypopnea index (AHI) was studied.

Results: The mean AHI while breathing room air was 23.33 (+/- 6.27). On breathing oxygen at 2 litres per minute AHI dropped to 8 (+/- 8.03). In 11 out of 12 patients, the AHI decreased from a mean of 23.09 to 6.36, while the AHI in 1 patient remained unchanged. Thus overall there was a significant improvement ($p < 0.001$) in AHI from 23.33 (+/- 6.27) to 8 (+/- 8.03) on breathing 2 litres per minute of nasally administered oxygen. Baseline oxyhaemoglobin saturation improved in all patients.

Conclusion: Nocturnal oxygen therapy has a beneficial effect on the obstructive sleep apnea syndrome in selected patients of ILD and OSAS.

Keywords: nocturnal hypoxemia, oxygen therapy, apnoea- hypopnea index (AHI), nighttime recording of respiratory variables (NTRRV)

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Introduction

Patients with interstitial lung disease (ILD) have a rapid, shallow breathing pattern while awake.[1, 2, 3, 4] This is thought to be due to vagally mediated reflexes; because vagal block can decrease the minute ventilation in patients with ILD. This high awake breathing frequency does not change significantly during sleep.[1]So it is likely that the reflexes causing rapid shallow breathing are still active during sleep. The resultant level of ventilation is usually excessive for the level of carbon dioxide (CO_2) production leading to hypocapnia.[4] These patients have a very disturbed sleep, with more arousals, sleep-stage changes and sleep fragmentation than normal subjects. Three patterns of oxygen (O_2) desaturation have been reported in patients with ILD during sleep. [4] The first and the most common is oxygen desaturation occurring primarily during REM sleep. In the second

Abbreviations: apnoea- hypopnea index (AHI) excessive daytime sleepiness (EDS), nighttime recording of respiratory variables (NTRRV)

pattern, there is a sustained fall in saturation during both NREM and REM sleep. The third group of patients consists of those who snore, some of whom have the classic obstructive sleep apnoea syndrome (OSAS). Patients of ILD with nocturnal hypoxaemia show an excellent response to supplemental oxygen, while use of continuous positive airway pressure (CPAP) is the now established treatment for OSAS. Supplemental oxygen used in patients with OSAS to prevent nocturnal hypoxemia has been reported to lengthen the duration of apnoeic spells and aggravate carbon dioxide retention during sleep.[5]However recent studies have demonstrated that low flow oxygen therapy may have beneficial effects in patients with sleep apnoea syndrome. [5, 6] No prior study is available on the effects of supplemental oxygen in patients of ILD with OSAS. In the present study, we have demonstrated the effects of nocturnal oxygen on patients of ILD with asymptomatic OSAS.

Methods

Twelve patients of ILD (8 patients of idiopathic pulmonary fibrosis, 2 patients of progressive systemic sclerosis, 1 of rheumatoid arthritis and 1 patient of sarcoidosis) with OSAS diagnosed on Nighttime recording of respiratory variables (NTRRV) using DENSA 2000 (UK) were included in the study. The parameters recorded are airflow with oro-nasal flow sensors, snoring by microphone, oxygen saturation by pulse oximetry, thoraco-abdominal movements and body position by sensors. Apnoea was defined as cessation of airflow for at least 10 seconds with a four percent fall in oxygen concentration. Hypopnoea was defined as a decrement in airflow of fifty percent or more associated with a four percent fall in oxygen saturation. Apnoea-hypopnoea index (AHI) was defined as the average number of apnoeas and hypopnoeas occurring per hour of study. [7] AHI of more than or equal to 10 per hour of study was considered abnormal.

Of the 12 patients, 5 were males and 7 were females, with their ages ranging from 26 to 78 years. Spirometry, high resolution computed tomography of chest, two-dimensional echocardiography and tissue biopsy was performed in all patients. Body mass index (BMI) was calculated. None of these patients had history suggestive of obstructive sleep apnoea syndrome in form of snoring, excessive daytime sleepiness or weight gain. All patients were then subjected to a repeat NTRRV using 2 liters per minute of continuous nasal oxygen for correcting the nocturnal desaturations. A beneficial effect of nocturnal oxygen on the apnoea-hypopnoea index was observed and analysed by the 't' test for paired observation.

RESULTS

Clinical profile of all patients is summarized in table 1. All patients had restrictive abnormality on spirometry. None except one patient was hypercapnic, mean daytime partial pressure of carbon dioxide was 36.39 (+/- 8.27). The mean partial pressure of oxygen was 71.88 (+/- 12.44) in awake state. Body mass index was less than 25 in all but two patients (both these patients had a BMI of 27). Pulmonary hypertension was present in five of the patients. Baseline NTRRV revealed predominantly obstructive events in all patients. The mean AHI was 23.33 (+/- 6.27). Repeat sleep study breathing 2 liters per minute of supplemental oxygen lead to a significant improvement ($p<0.001$) in the AHI to 8 (+/- 8.03) (as shown in table1 and figure 1).

In 11 out of 12 patients, the AHI decreased from a mean of 23.09 to 6.36; while in one patient AHI remained unchanged. Thus overall there was a significant ($p<0.001$) fall in AHI from 23.33 (+/- 6.27) to 8 (+/- 8.03) on breathing 2 liters per minute of nasally administered oxygen during sleep. Baseline oxyhaemoglobin saturation improved in all patients.

Discussion

Previous studies have shown that oxygen supplementation has a deleterious effect on sleep apnoea syndrome by prolonging the apnoeas and hypopnoeas. This is thought to result from removal of hypoxic ventilatory drive by supplemental oxygen. [6, 8, 9]However, in our study we observed a significant ($p<0.001$) reduction in AHI on breathing 2 liters per minute of oxygen. In similarity to the present study, Philip et al [6]demonstrated that breathing 3 liters per minute of oxygen produced a significant improvement in sleep-disordered breathing and in baseline oxyhaemoglobin saturation in 12 patients with sleep apnoea syndrome. Another study evaluating the effects of low flow oxygen in nine obese patients with mixed apnoeas reported a considerable decrease in the central events, but an increase in the frequency of obstructive events. [10]

Several explanations have been given to explain the

Table 1: Effect of oxygen on apnoea hypopnoea index

SR NO	AGE (Yrs)	SEX	DIAGNOSIS	BMI Kg/m2	FVC%	PCO2	PO2	PHT	BASELINE AHI*	BASELINE SaO2	2 L/m OXYGEN AHI*	2 L/m OXYGEN SaO2
1	60	F	IPF	27	53	40.2	71.6	NO	26	78	26	81
2	35	M	SARCOID	21.4	37	23	95	YES	26	75	18	81
3	47	F	PSS	15	34	43	84	YES	30	63	7	79
4	78	M	IPF	20	35	31	65	YES	24	87	1	91
5	60	F	IPF	23.1	32	34.4	62.2	NO	31	85	10	91
6	47	M	IPF	21.8	45	23	65		32	88	5	97
7	52	M	IPF	27	45	37	68.1	NO	19	86	14	92
8	36	F	IPF	24	47	41.5	69.8	NO	19	88	0	96
9	26	F	PSS	16.5	19	31.9	65.6	YES	23	79	9	80
10	45	F	RA	20.4	31	51.5	51	NO	21	55	0	94
11	70	F	IPF	23.6	28	40.1	75.2	YES	19	55	1	98
12	47	M	IPF	22.6	74	40.1	90	NO	10	89	5	90
MEAN				21.87	40	36.39	71.88		23.33	77.33	8	89.17
SD				3.62	14.22	8.27	12.44		6.272	12.8	8.034	7.043

P*=0.000081

IPF-Idiopathic pulmonary fibrosis; PSS-Progressive systemic sclerosis; RA-Rheumatoid arthritis; SARC-Sarcoidosis; BMI-Body mass index; PHT-Pulmonary hypertension; FVC-Forced vital capacity; AHI-Apnoea-hypopnoea index; SaO2-Minimum oxygen saturation

beneficial effect of oxygen on sleep-disordered breathing. Walter et al [5]have suggested that hypoxaemia might be a critical factor in pathogenesis of sleep related disorders, by resulting in hypoxia induced brainstem depression. Lack of ventilatory response to hypoxaemia could be due to a defect in the peripheral chemoreceptors or in central integrative respiratory neurons. This may allow initial mild degree of hypoxaemia produced during sleep to deteriorate sufficiently to the point of brain stem depression. Hence, supplemental oxygen, by relieving the hypoxic brain stem suppression, could result in an increase in level of ventilation and a reduction in number of apnoeic spells. [11]

The second proposed hypothesis is based on the destabilizing influence of the hypoxic ventilatory response on respiratory control. As at high altitude, hypoxia may lead to hyperventilation, yielding hypocapnia and alkalosis, which in turn may inhibit respiration during sleep. Thus cyclical ventilation may develop with apnoeas occurring at the nadir of this periodic breathing. Both central and obstructive apnoeas may result, depending upon the propensity of the upper airways to collapse, when cyclical output to respiratory muscles occurs during sleep. With the administration of oxygen, the hypoxic influence on ventilation may be reduced and breathing regularized. [11]

Thus from the present study we conclude that nocturnal oxygen supplementation has a beneficial effect on the AHI in a selected group of patients with ILD and OSAS. Ours is a preliminary study and more studies are required before oxygen can be prescribed as a therapy for patients with ILD and OSAS.

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