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Original article

POLYSOMNOGRAPHY IN PATIENTS WITH METABOLIC SYNDROME AND THEIR RELATIONSHIP WITH OSAS

Dr. Tapan Surana[1] (Assistant Professor) & Dr. Dilip Chawda[2] (Assistant Professor)

Department of Department of Respiratory Medicine, LNCT Medical College & Sewakunj Hospital, Kanadia, Indore (M.P.), India[1&2]

Corresponding Address: Dr. Tapan Surana

Abstract

Aim: The aim of our study was to study the clinical and sleep profile in patients with Metabolic Syndrome and sleep disturbances by polysomnography. We also studied the association of Metabolic Syndrome and Obstructive Sleep Apnea Syndrome.

Materials & Methods: This is a prospective observational study conducted on 76 patients of metabolic syndrome. National Cholesterol Education Program - ATP III protocol was used for the diagnosis of metabolic syndrome. All the patients fulfilling the inclusion criteria were subjected to whole night polysomnography. We compared the sleep related complaints and individual risk factors of metabolic syndrome with Apnea-Hypoapnea Index (AHI). We also did a subgroup analysis by age, sex, sleep complaints and sleep profile.

Results: In our study we found a significant correlation on comparison of hypertension to the AHI of the patients and no correlation between diabetes mellitus and AHI. It was also seen that deranged lipid profile leads to higher AHI. Abdominal circumference and BMI were cross tabulated with AHI and significant correlation was seen. When the patients of metabolic syndrome were subdivided by the number of risk factors they fulfil, it was found that as the number of risk factors increases, the chances of higher AHI scores also increases.

Conclusion: The close relation between metabolic syndrome and OSAS may be due to the common mechanistic links between the two. All the patients with metabolic syndrome should be considered as potential risk for developing OSAS and should be evaluated extensively including polysomnography.

1. Introduction

Obstructive sleep apnoea is a condition characterized by repetitive upper airway collapse during sleep, recurrent arousals, intermittent hypoxemia and sleep fragmentation. Sleep of poor quality and small duration have adverse effects on metabolic and hormonal processes leading to increased cardiovascular risk. Sleep disturbances provoke sympathetic activity, contributes to systemic inflammation and oxidative stress, and impair vascular endothelial function. Obstructive sleep apnoea is increasingly recognized to be an independent cardiovascular risk factor [1]. There is intense research interest in the association between obstructive sleep apnoea and the metabolic syndrome - the constellation of metabolic disorders sharing pathophysiologic pathways including central obesity, dyslipidaemia, insulin resistance and hypertension, which appears to directly promote the development of atherosclerosis [2].

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Aims and Objectives

The aim of our study was to study the clinical and sleep profile in patients with Metabolic Syndrome and sleep disturbances by polysomnography. We also studied the association of Metabolic Syndrome and Obstructive Sleep Apnea Syndrome.

2. Material and Methods

The protocol was designed in accordance with the standard of the ethics committee for protection of human subjects. The study duration was 18 months with a sample size of 76.

Inclusion criteria was patients with metabolic syndrome who have given informed and written consent and were able to complete full night polysomnography. Patients unable to undergo complete polysomnography or sign informed consent and patients with severe cardiovascular comorbidities were excluded. The selected patients underwent complete clinical evaluation including a detailed proforma directed history, thorough clinical examination and body measurements. All patients underwent routine diagnostic tests as per the standard hospital practice.

Initial Evaluation: Patients were diagnosed as metabolic syndrome on the basis of criteria set up in National Cholesterol Education Program (NCEP) - Adult Treatment Protocol III. 84 patients were initially admitted through OPD and evaluated under the preset inclusion and exclusion criteria. Out of these, 8 patients were excluded on the basis of exclusion criteria.

Patients who had three or more than three of the risk factors mentioned above were said to have Metabolic Syndrome. For each enrolled subject, detailed history of symptoms like snoring, daytime sleepiness, restlessness during sleep, morning headache, trouble concentrating and waking up in the middle of the night were taken. Epworth Sleepiness Scale **(**ESS) for daytime sleepiness was used and patients were categorized accordingly.

For each enrolled subject detailed physical and clinical examination was done including height, weight, Body Mass Index, oral, nasopharyngeal examination, Mallampatti grading. Emphasis were put on abdominal and neck circumference measurements. Investigations performed included hemogram, lipid profile including TG, LDL, HDL, VLDL and cholesterol levels alongwith fasting and post prandial blood sugar levels. Finally, 76 patients were subjected to Level-1 polysomnography on Alice-5 Respironic (Philips) 56 channels machine. Patients were diagnosed and classified as per the criteria given by American Academy of Sleep Medicine.

3. Results

In this study we found that all the patients (46) with moderate to severe AHI scores had snoring and only 6 patients without snoring had deranged AHI scores. 42 (91.3%) cases with moderate to high AHI had daytime sleepiness present. But it is also seen that all the patients (30) with minimal to mild AHI had daytime sleepiness present. On comparing the ESS scores with the AHI of the patients it was found that 100% of the cases with severe excessive daytime sleepiness had Moderate to severe AHI scores while 75% with moderate daytime sleepiness had moderate to high AHI scores. It was also seen that 70% of the cases with

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normal ESS scores had minimal to mild AHI while patients with mild daytime sleepiness, the ratio was almost same.

Table No. 1
Comparison of patients with Hypertension and their AHI

Hypertension		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
Absent	Count	18	12	30
	%	60.0%	40.0%	100.0%
Present	Count	12	34	46
	%	26.1%	73.9%	100.0%
Total	Count	30	46	76
	%	39.5%	60.5%	100.0%

Pearson Chi Square = 8.741, p=0.003, Significant

- The above table shows that out of 46 cases with hypertension, 34(73.9%) had moderate to severe AHI while 12(26.1%) had minimal to mild AHI.
- It is also seen that 18 (60%) cases without hypertension had mild AHI as compared to 12 (40%) with moderate to severe AHI.

Table No. 2
Comparison of patients with Diabetes Mellitus and their AHI

Diabetes Mellitus		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
Absent	**Count**	**4**	**12**	**16**
	%	**25.0%**	**75.0%**	**100.0%**
Present	**Count**	**26**	**34**	**60**
	%	**43.3%**	**56.7%**	**100.0%**
Total	**Count**	**30**	**46**	**76**
	%	**39.5%**	**60.5%**	**100.0%**

Pearson Chi Square = 1.777, p=0.183, Not Significant

- The above table shows that out of 60 patients with DM-II, 34(56.7%) cases had moderate to severe AHI while 26(43.3%) had minimal to mild AHI.

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- 12 (75%) cases without diabetes had moderate to severe AHI.

Table No. 3
Comparison of patients with Obesity and their AHI Index

Obesity		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
Absent	Count	8	2	10
	%	80.0%	20.0%	100.0%
Present	Count	22	44	66
	%	33.3%	66.7%	100.0%
Total	Count	30	46	76
	%	39.5%	60.5%	100.0%

Pearson Chi Square = 7.916, p=0.005, Significant

- In the above table we can see that out of 66 cases with obesity, 44 (66.6%) cases had moderate to severe AHI while 22(33.3%) cases had minimal AHI.
- Only 2 cases without obesity had moderate to severe AHI while other non-obese (22) had minimal to mild AHI.

Table No. 4
Comparison of patient's Abdominal circumference and their AHI

Abdominal Circumference		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
<102 cm in Male/<88cm in Female	Count	8	2	10
	%	80.0%	20.0%	100.0%
>102 cm in Male/>88cm in Female	Count	22	44	66
	%	33.3%	66.7%	100.0%
Total	Count	30	46	76
	%	39.5%	60.5%	100.0%

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Pearson Chi Square = 7.916, p=0.005, Significant

- In the above table, it was found that 44(66.7%) cases with increased abdominal circumference had moderate to severe AHI while 22(33.7%) had minimal AHI. It was seen that only 2 patients with normal waist size had higher AHI.

Table No. 5
Comparison of patient's triglyceride levels and their AHI

Triglyceride Levels		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
Normal	Count	4	4	8
	%	50.0%	50.0%	100.0%
Raised	Count	26	42	68
	%	38.2%	61.8%	100.0%
Total	Count	30	46	76
	%	39.5%	60.5%	100.0%

Pearson Chi Square = 0.415, p=0.520, Not Significant

- In the above table we can see that equal number of cases with normal triglyceride levels were present in both the AHI categories.
- In the patients with raised triglyceride levels, 42(61.8%) had more AHI scores as compared to 26(38.2%) cases who had minimal to mild AHI.

Table No. 6
Comparison of Number of Risk Factors of Metabolic Syndrome with AHI

		AHI		Total
		Minimal to Mild (0-15)	Moderate to Severe (>16)	
Number of Risk factors of Metabolic Syndrome	3 Risk Factors	24	14	38
	4 Risk Factors	6	30	36

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	5 Risk Factors	0	2	2
Total		30	46	76

Chi Square Test = 18.076, p = 0.001
On calculation of the p value, it came out to be 0.001 which showed significant association between number of risk factors and AHI.

4. Discussion

In our study 76 cases of metabolic syndrome underwent polysomnography. The mean age group in the study was 54.5 years and majority of the patients (76.3%) were males and 23.7% were females. Our study showed that majority of patients 70 (92.1%) had history of snoring during sleep while only 6(7.9%) patients did not complain of snoring. Snoring have been frequently associated with metabolic syndrome and it is one of the most common presenting complaint encountered. According to a study by Sun L *et al*, frequent snoring was associated with an elevated Metabolic Syndrome risk independent of other risk factors [3]. Another study by Leineweber C states that snoring may be a strong predictor for metabolic syndrome in middle-aged women [4].

In our study we found that 60.5 % of patients were hypertensive and 39.5% we normotensive. It was found that out of 46 cases with hypertension, 34(73.9%) had moderate to severe AHI while 12 (26.1%) had minimal to mild AHI. It was also seen that 18 (60%) cases without hypertension had mild AHI as compared to 12(40%) with moderate to severe AHI. Various previous studies have concluded that not only does OSAS predispose patients to developing HTN, but also there is a greater incidence of OSAS in hypertensive patients [5]. The Wisconsin Sleep Cohort Study found a relationship with increasing OSAS severity and incidence of HTN, independent of confounding risk factors [6]. The mechanisms for hypertension in OSAS are numerous and vary like increased sympathetic tone, inflammation, endothelial dysfunction, peripheral vasoconstriction, increased RAAS, heightened chemoreflex, and blunted baroreflex sensitivity.

60 (78.9%) patients included in the study had diabetes mellitus while 16 (21.2%) patients were non diabetic. Out of 60 patients with DM-II, 17(56.7%) cases had moderate to severe AHI while 26(43.3%) had minimal to mild AHI. 12 (75%) cases without diabetes had moderate to severe AHI. In a multi ethnic study by Mahmood K [7] it was found that OSA is not independently associated with type 2 diabetes in a predominantly African American and Hispanic sample. However, the relationship of OSA with type 2 diabetes was statistically significant. In another study by Parish JM et al, no significant association was found between diabetes mellitus II and OSAS [8]. Both of the above mentioned studies were retrospective studies and relied on existing records for data collection. The data the sample size in both were larger as compared to our study.

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Out of 66 cases with obesity, 44 (66.6%) cases had moderate to severe AHI while 22(33.3%) cases had minimal AHI. Only 2 case without obesity had moderate to severe AHI while other non-obese (22) had minimal to mild AHI. A study by Rajala R indicates that the severity of sleep apnea was generally greater than that found in leaner clinical populations [9]. In addition, Peppard and colleagues have provided further evidence for a link between sleep apnea and obesity by demonstrating that a 10% change in body weight was associated with a parallel change of approximately 30% in the apnea–hypopnea index (AHI), the major index of sleep apnea severity [10]. The association may be attributed to the fact that obesity and particularly central adiposity can increase sleep apnea susceptibility by increasing upper airway mechanical loads and/or decreasing compensatory neuromuscular responses. These effects may be mediated by circulating adipokines, which influence body fat distribution and CNS activity [11].

In our study we saw that equal number of cases with normal triglyceride levels were present in both the AHI categories. In the patients with raised triglyceride levels, 42(61.8%) had more AHI scores as compared to 26(38.2%) cases who had minimal to mild AHI. The association of raise triglycerides to AHI severity was not significant. The clinical evidence linking obstructive sleep apnea with triglyceridemia is limited. In a study by Drager et al, they found increasing relationship between intermittent hypoxia and dyslipidemia [12]. However, the role of triglyceridemia with OSA remains to be established. Borgel et al in their study found that there was improvement in mean lipid/lipoprotein serum levels in all subjects with initial dyslipidemia through Bi-/CPAP therapy which is the mainstay therapy for OSAS [13].

In our study we found that out of 64 cases with increased neck circumference, 40(62.5%) had moderate to severe AHI while 24(37.5%) had mild AHI. In patients with normal neck circumference, equal number of cases were in both the AHI categories. On calculating the p value, it was not found to be significant.

On comparing abdominal circumference with AHI scores, it was found that 44(66.7%) cases with increased abdominal circumference had moderate to severe AHI while 22(33.7%) had minimal AHI. Only 2 patient with normal waist size had higher AHI. On calculating the p value came out to be 0.005 which is significant. In a study by Sînziana Lovin et al, they concluded that abdominal adiposity may predict OSAS severity better than neck circumference [14]. Abdominal obesity has been one of the main factors in developing OSAS since it leads to raising of the diaphragm, increased workload of breathing and thus causing sleep disturbances. It is also one of the major risk factor of metabolic syndrome which itself leads to OSAS.

On comparing the ESS scores with the AHI of the patients it was found that 100% of the cases with severe excessive daytime sleepiness had Moderate to severe AHI scores while 75% with moderate daytime sleepiness had moderate to high AHI scores. It was also seen that 70% of the cases with normal ESS scores had minimal to mild AHI while patients with mild daytime sleepiness, the ratio was almost same. On calculating the p value, it was found to be 0.001 thus showing that significant co-relation between ESS and AHI scores. Lee et al concluded in their study that apnea/hypoxemia has considerable coherence to account for the EDS measured by ESS in OSA patients [15]. It is to be kept in mind though that ESS scoring

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has its own limitations in terms of language used in questionnaire and that the scoring should be done with the patient's partner present. Thus it is mostly used as a screening tool.

We found that there was significant association between number of risk factors of metabolic syndrome and AHI. By definition, metabolic syndrome is said when a person fulfils atleast three or more of the five risk factors given in NCEP ATP III criteria. Here in our study we can see that as the number of risk factors increases, the chances of higher AHI scores also increases.

5. Conclusion

Metabolic syndrome is a significant problem in our country not just confined to urban population but also seen in rural areas. So patients of metabolic syndrome with sleep related complaints should necessarily be evaluated by sleep studies so that problems like OSAS can be diagnosed and appropriately managed.

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