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Original Article

Effect of Obstructive Sleep Apnea on Sleep Pattern and Blood Glucose Level in Type 2 Diabetes Patients

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ABSTRACT

Introduction: Our physical, mental, and emotional well-being require normal sleep. Disturbances in sleep quality and quantity can result in metabolic disorders. Sleep fragmentation increases sympathetic activity which leads to decreased insulin sensitivity. Obstructive sleep apnea causes sleep fragmentation. That is why this study attempt is made to find the effect of obstructive sleep apnea on sleep pattern and blood glucose level in type 2 diabetes patients.

Materials and Method: Depending on the severity of the Apnea-Hypopnea Index (AHI) recorded by polysomnography, each, volunteer were divided into two groups, a) AHI>10 groups, and b) AHI≤10 groups. Then the comparison of all the parameters between AHI>10 and AHI≤10 groups of diabetic participants was done.

Results: In participants of AHI≤ 10 groups, Sleep efficiency%, Mean TBI SPo2%, sleep Stage III%, and REM% are significantly higher as compared to AHI>10 groups. In participants of the AHI>10 groups, sleep Stage I%, the score of ESS, and fasting blood glucose level are significantly higher as compared to AHI≤ 10 groups.

Conclusions: Increasing AHI is associated with reduced sleep efficiency; a sleep stage of N3%, and a REM sleep phase, which lead to an increase in fasting blood glucose levels in the diabetic group.

Keywords: Apnea-hypopnea index; Epworth sleepiness scale; Rapid eye movement sleep; Oxygen saturation;

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INTRODUCTION

Our physical, mental, and emotional well-being require normal sleep. Disturbances in sleep quality and quantity can result in metabolic disorders and cardiovascular dysfunction.[1]

Sleep helps to maintain normal sympathetic activity which is why sleep fragmentation increases sympathetic activity. Increased sympathetic activity decreases insulin sensitivity and increases blood sugar levels. It also increases systemic arterial blood pressure.[2,3] If transient hypoxia occurs in a healthy person due to any reason causes elevation of epinephrine, norepinephrine, and cortisol in the body.[4,5] Elevation of epinephrine our body increases hepatic gluconeogenesis and decreases skeletal muscle glucose reuptake, which finally causes hyperglycemia.[6]

The amount of sleep, as well as quality of sleep, is important in the metabolic function of type 2 diabetes patients.[7] In obstructive sleep apnea (OSA) recurrent episodes of complete obstruction or partial obstruction of the upper airways occur during sleep, leading to sleep fragmentation, and intermittent hypoxia.[8]

Therefore the aim of this study is to find whether obstructive sleep apnea alters sleep quality and quantity or not. If it is altering sleep quality and quantity then what is its effect on the blood glucose level of study participants.

MATERIALS AND METHODS

This was a comparative study that was carried out in the Sleep Research Center, MGM Hospital, KamotheNavi Mumbai. Type 2 diabetic patients who consented to participate in the study and visit the sleep research Centre, MGM Hospital, KamotheNavi Mumbai, for diagnosis of a sleep-related problem were enrolled in the study. Type 2 diabetic patients with Long-term complications like retinopathy, nephropathy, cardiopulmonary and neurological diseases were excluded from this study. Polysomnography for all these volunteers was done from 10 pm to 6 am and around 6:30 am. After polysomnography, a fasting blood sample was collected to do glycosylated haemoglobin and fasting blood sugar test.

The glucose test was performed by the glucose oxidase-peroxidase method and glycosylated haemoglobin (HbA1c) was done by the ion exchange chromatography method. Depending on the severity of the Apnea-Hypopnea Index (AHI) recorded by polysomnography, the volunteers were divided into a) AHI>10 groups and b) AHI≤10 groups. Then a comparison of all the parameters between AHI>10 and AHI≤10 groups of diabetic participants was done.

All data collected were statically analyzed using SPSS 19.0. software. The data were presented using descriptive statistics such as mean, and standard deviation (SD). Further comparison between AHI>10 groups and AHI≤10 groups was done using an independent sample t-test. The recorded values were expressed as Mean±SD. The level of significance was set at 5%. All p–values less than 0.05 were considered to be significant.

RESULT

A total of 30 patients with diabetes mellitus who visited a sleep research center for sleep apnea were enrolled in the study. The mean age was compared among the group of patients with AHI <10 and AHI >10 (52.82±6.95 vs. 51.26±10.59 years). Comparison of polysomnographic parameters and ESS were analysed and shown in table 1 which shows sleep efficiency (%), and sleep Stages (I-III) in percentage. REM sleep % decreased significantly with increasing AHI and sleep Stage I%and ESS increases significantly with increasing AHI. Sleep Stage II% also increases increasing AHI but there is no significant difference between the groups. (Table 1) Increasing AHI decreases oxygen saturation in participants of AHI>10 groups but there is no significant difference in oxygen saturation between the groups.

Table 1: Comparison of parameters of polysomnogram and ESS of diabetic groups

Parameters	AHI>10 (n=19)	AHI≤ 10 (n=11)	p-values (t-test)
Age (year)	51.26±10.59	52.82±6.95	0.63
AHI	38.61±26.91	4.66±3.11	0.00003**
Sleep efficiency%	78.07±11.05	91.35±6.45	0.00028**
sleep Stage I%	30.03±16.15	18±11.8	0.0272*
sleep Stage II%	52.35±13.66	43.18±12.08	0.07
sleep Stage III%	9.03±9.50	30.54±30.42	0.04*
REM sleep %	9.01±6.04	18.9±13.48	0.04*
Mean TBI SPo2%	93.3±3.53	95.3±1.80	0.054
ESS	16.74±6.41	11.64±5.05	0.02*

Mean fasting blood glucose lable and HbA1c were analysed among the patients with AHI >10 and AHC <10 and is depicted in table 2. The table shows, a significantly higher fasting blood glucose level (mg/dl) level in participants of AHI>10 group. HbA1c % is also higher in participants of AHI>10 groups but there is no significant difference of HbA1c % between the groups.

Table 2: Comparison of blood parameters of diabetic groups.

Parameters	AHI>10 (n=19)	AHI≤ 10 (n=11)	p-values (t test)
HbA1c %	7.68±1.45	7.22±1.63	0.41
Fasting Blood Glucose level (mg/dl)	145.08±37.6	117.07±24.34	0.02*

DISCUSSION

In Obstructive sleep apnea, throat muscles intermittently relax and block the airway during sleep. Its frequency and intensity increase dung sleep stage N3 and REM sleep, which lead to severe hypoxia and make the patient wake up from sleep. Because of repeated waking up from N3 and REM sleep in Obstructive sleep apnea, the percentage of these stages of sleep, as well as sleep efficiency, decreases. Sleep duration, sleep quantity (Sleep efficiency), and sleep quality (different stages of sleep) are important for health so all these factors must be in their normal range for a healthy life.[9]

Sleep duration, sleep quantity (Sleep efficiency), and sleep quality are important for restoring the immune, skeletal, and nervous systems. It is also important for an anabolic state of most of the body's systems during sleep and for maintaining memory, mood, and cognitive performance.[10]

Deep sleep (stage N3 sleep) dominates the parasympathetic branch of the autonomic nervous system of our body. When sleep stage N3 decrease below its normal range, domination of the parasympathetic branch of the autonomic nervous system doesn't take place which causes increased sympatric activity.[11,12] This increased sympathetic activity itself increases insulin resistance[2,3] and also causes excess secretion of Corticotropin-releasing hormone (CRH) from the hypothalamus. CRH causes the release of excess cortisol and then this cortisol raises blood glucose concentrations. Both REM and deep sleep are also essential for memory.[13]

In concordance with our study, Daniela Grimaldi et al observed no significant differences in HbA1c level between subjects with and without OSA.[14]

Hui P et al in 2016noted significantly higher AHI, SBP, DBP, Fasting blood glucose level, and HbA1c (%) in moderate, severe hypoxemia groups as compared to mild hypoxemia group.[15] Our study shows similar finding except there is no significant differences in HbA1c level between the groups in our study.

They also found higher REM sleep (%), and sleep stage N3(%) in the mild hypoxemia group as compared to moderate and severe hypoxemia groups even though AHI was significantly higher in moderate, severe hypoxemia groups as compared to mild hypoxemia groups and the difference was not statically significant. Sleep stages N1 and N2 were higher in the moderate and severe hypoxemia group as compared to a mild group and the difference was not significant. There was a significantly higher Average SpO2 (%) in the mild hypoxemia group.[15] Our study shows significantly higher sleep efficiency, sleep stage 3 and REM sleep in AHI≤10 group, and sleep stage N1 is significantly higher in AHI>10 group.

Lam et al noted no significant difference in HbA1c % and fasting glucose between the OSA group and without OSA group with type 2 diabetes.[16] In our study fasting blood glucose is significantly higher in AHI>10 group as compared to AHI≤10 groups with type 2 diabetes.

Priou P et al found that in untreated diabetic patients, HbA1c was positively associated with apnea-hypopnea index and 3% oxygen desaturation index.[17] In our study HbA1c is higher in AHI >10 group as compared to AHI≤10 group but the difference is not statistically significant.

Renee S et al in 2010noted significantly higher sleep efficiency%, REM sleep, and insignificantly higher slow wave sleep in the non-OSA group than the OSA group with type 2 diabetes. In OSA group sleep stage 1 and sleep stage 2 is insignificant higher.[18]Our study shows similar finding except for significantly higher slow wave sleep (N3) in AHI≤10 groups and significantly higher sleep stage 1 in AHI>10 groups. Alnaji A et al noted an association between poor glucose control and both short and long sleep durations in people with established diabetes.[19] Our study shows similar findings. Lee SW et al in2017 found that amount of sleep, as well as quality of sleep, is important in the metabolic function of type 2 diabetes patients.[20]our study shows a similar finding.

CONCLUSIONS

Increasing AHI is associated with reduced sleep efficiency; sleep stage N3%, and REM sleep phase, which leads to an increase in fasting blood glucose levels in the diabetic group.

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