Original Article

Obstructive Sleep Apnea among Individuals Admitted for Myocardial Infarction

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Abstract

Background and Objective: Obstructive sleep apnea (OSA) is the most common respiratory disorder during sleep and a risk factor for myocardial ischemia. In this study, we evaluated the proportion of subjects at high risk for OSA and prevalence of its predictors among patients admitted for acute myocardial infarction (MI).

Materials and Methods: A total of 210 patients with MI admitted at the cardiac care unit of Baharloo Hospital, Tehran, Iran were enrolled in this study. The STOP-BANG questionnaire was used for diagnosing high-risk patients of OSA. Anthropometric and demographic characteristics, family and personal history, results of biochemical tests, and the time of the onset of MI in patients were recorded.

Results: Based on the STOP-BANG questionnaire, 112 patients (53.3%) were at high risk for OSA. The level of fasting blood sugar (FBS) was significantly higher in high-risk patients for OSA. Regression analysis showed that FBS could be a predictor of OSA in patients with MI (*P* value: 0.005). From midnight to 5:59, the frequency of the onset of MI was significantly higher in patients at high risk for OSA compared with those at low risk (42% vs. 16.3%, $P < 0.001$).

Conclusions: OSA is a prevalent disorder in patients with MI. Looking for signs and symptoms of OSA should be considered in clinical assessment of MI patients.

Keywords: Obstructive sleep apnea, Myocardial infarction, Day-night variation

Introduction

Obstructive sleep apnea (OSA) is the most common respiratory disorder during sleep. OSA affects 24% and 9% of men and women, respectively, in their middle age with more prevalence in the obese population (1). Untreated OSA leads to many complications particularly cardiovascular problems such as hypertension, arrhythmia, congestive heart failure, coronary artery disease, and pulmonary hypertension (2-5). Studies have shown that in addition to hypertension, there are other mechanisms that may cause cardiovascular damages of OSA such as endothelial damage, hypoxia leading to atherosclerosis, decrease in vascular vasodilatory response, increase in platelet aggregation, and increase in the chronic sympathetic activity as the most important effect (6-9). Based on the epidemiologic studies, OSA is one of the risk factors of coronary artery disease and myocardial infarction (MI) (10,11). In various studies, prevalence of OSA in MI patients is estimated from 30-79% (12-16).

MI is one of the most common causes of mortality all over the world. In a cohort study in Iran, the incidence rate of MI was reported as 352 in men and 186 in women per 100000 person-years (17). Diagnosing and treating OSA at early stages could decrease the MI related mortality and morbidity. It has been shown that continuous positive airway pressure (CPAP), as the primary therapy for OSA, reduces cardiovascular risk in patients with OSA (18).

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Polysomnography (PSG) is the gold standard test for OSA diagnosis (19). This test is expensive and time-consuming; therefore for predicting OSA several questionnaires are introduced and validated. The STOP-BANG questionnaire was designed for OSA screening in 2008 (20). This questionnaire classifies patients as being at high or low risk for OSA. In this study, authors aimed to evaluate the prevalence of subjects at high risk for OSA and related risk factors among patients admitted for acute MI. Moreover, day-night variation of the MI was compared between patients at high and low risk for OSA.

Materials and Methods

For this cross-sectional study, 210 consecutive patients admitted for acute MI at the cardiac care unit of Baharloo Hospital, Tehran, Iran from January 2012 to April 2014 were enrolled. The diagnosis of MI was made by the patients' physician (Cardiologist) according to the recommendations of American Heart Association. Patients with known OSA, those who were intubated and receiving mechanical ventilation and those who were unable to give the precise hour of their first clinical symptoms were excluded from the study. We used the STOP-BANG questionnaire for diagnosing high-risk patients for OSA (20). The STOP-BANG questionnaire consists of four dichotomous (yes/no) questions evaluating snoring, tiredness during the day, stopped breathing observed by another individual during sleep and having or being treated for high blood pressure plus four items about Body Mass Index (BMI), age, neck circumference, and sex. BMI more than 35 kg/m^2, age more than 50 years, neck circumference more than 40 centimeters and male sex were considered as positive scores. Patients with a score of three or more based on STOP-BANG questionnaire were identified to be at high risk for OSA.

Systolic and diastolic blood pressure, height, weight, neck, hip and waist circumferences of patients were measured. Family history of MI and personal history of smoking, diabetes mellitus (DM), hyperlipidemia (HLP) and hypertension (HTN) were recorded. Blood level of creatine kinase (CK), fasting blood sugar (FBS), serum triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and total cholesterol of patients were collected from patients' records.

Patients were briefed in detail about the study, and written informed consent was obtained from all of them. The study was conducted with the approval of the institutional review board of the Tehran University of Medical Sciences, Iran.

Statistical analysis

All measurements are presented as mean (± standard deviation) or percentages. Mann–Whitney U test was used for comparing continuous variables and the χ^2 test was used to assess differences in qualitative data and the frequency distributions of MI for the 6-h intervals of the day between high risk and low risk patients for OSA. The linear regression analysis was performed for assessing predictors of OSA. All P values were two-tailed and $P<0.05$ was considered statistically significant. Predictive Analytics Software for Windows (PASW) version 18.0 was used for the statistical analysis.

Results

We studied 210 patients (162 men) with mean (±SD) age of 59 ± 12.3 years and the mean (±SD) BMI was 26.7 ± 4 kg/m^2. Based on the STOP-BANG questionnaire, 112 (53.3%) patients were at high risk for OSA.

There was no difference between low and high-risk patients for OSA regarding demographic and anthropometric characteristics (Table 1). The level of FBS in high-risk group for OSA was significantly higher than low risk (P value: 0.03, Table 1). The two groups were similar in proportion of family history of MI and personal history of DM, HTN, HLP, and smoking (Table 2).

Table 1. Demographic and anthropometric characteristics of study participants.

Characteristic	All (n=210)	Low risk for OSA (n=98)	High risk for OSA (n=112)	*P* value
Male (%)	162 (75.7)	80 (83.8)	82 (69.5)	0.09
Age (years)	59 (12.3)	57.9 (11.3)	59.8 (13.3)	0.44
Height (cm)	169.5 (8.3)	170.9 (8.6)	168 (8.2)	0.13
Weight (kg)	76.6 (13.7)	75.4 (16)	77.2 (11.6)	0.54
BMI (kg/m^2)	26.7 (4)	25.9 (4.5)	27.4 (3.5)	0.09
Waist circumference (cm)	101.5 (8.2)	101 (10.6)	101.1 (7.73)	0.97
Hip circumference (cm)	104.5 (9.6)	107 (9.8)	102.1 (10.1)	0.37
Neck circumference (cm)	42.7 (6.3)	41.2 (7.1)	43.8 (6)	0.45
Systolic BP (mmHg)	126.4 (21.6)	126 (18.7)	125.2 (23.1)	0.84
Diastolic BP (mmHg)	77.9 (12.6)	79.2 (12.8)	76.4 (11.6)	0.23

OSA: obstructive sleep apnea, BMI: body mass index, BP: blood pressure
Data are presented as mean (standard deviation) except variable of male gender that is presented as number (percent).

Regression analysis showed level of FBS to be a predictor for OSA (β=0.002, se=0.001, *P*=0.005).

Figure 1 presents the distribution of the onset of MI in 6-h time interval according to the risk for OSA. As shown, the onset of MI in the interval from midnight to 5:59 was observed in 63 patients; 47 were classified as being at high risk for OSA. As presented in Figure 2, from midnight to 5:59, the frequency of the onset of MI was significantly higher in patients at high risk for OSA compared with those at low risk (42% vs. 16.3%, *P*<0.001) whereas from 12 to 17:59, the frequency of the onset of MI was significantly higher in patients at low risk for OSA compared with those at high risk (42.9% vs. 18.8%, *P*<0.001).

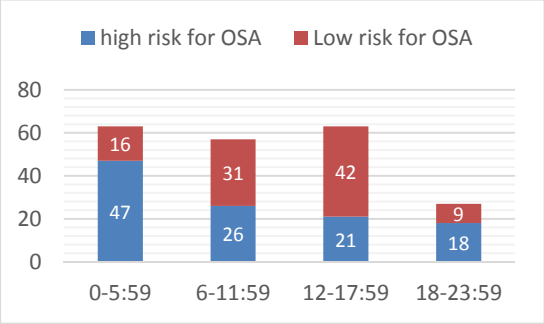

Figure 1. Patients with onset of MI in 6-hrs time interval according to the risk for OSA

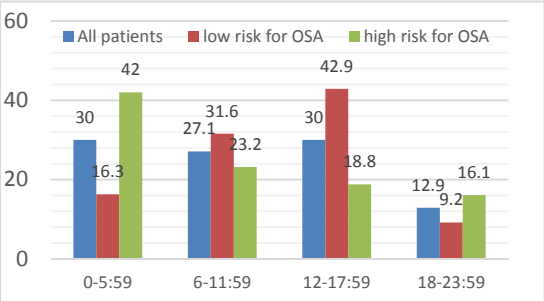

Figure 2. Day-night pattern of the onset of MI in 6-h time interval according to the risk for OSA

Discussion

The close association between OSA and cardiovascular diseases has been increasingly reported in the preceding years. We conducted a cross-sectional study in one of the principal heart centers of Tehran, to find the proportion of subjects at high risk for OSA and prevalence of its risk factors among patients admitted for acute MI.

Present study showed that OSA is a high prevalent disorder in patients with acute MI. Using the STOP-BANG questionnaire, current study indicated that 53.3% of patients with MI were at high risk for OSA. Several studies have reported the prevalence of OSA among patients with MI using the apnea-hypopnea index (AHI) on PSG. Aboyans et al. in a study of 45 patients admitted for acute MI reported that 30% of participants had AHI>10 (15). A study by Nakashima et al. in 86 Japanese patients admitted to the hospital with acute MI reported that 43% of patients had AHI ≥ 15 (14). Lee et al. in a study of 120 MI patients found that 65.7% had undiagnosed OSA determined by AHI ≥ 15 (13). Fumagalli et al. assessed 191 patients after an ST-elevation MI by PSG and found that 74.9% had AHI>5 (12). Ben Ahmad et al. selected 120 patients hospitalized for ST elevation of MI and reported that 79% had OSA defined as AHI ≥ 5 (16).

Table 2. Laboratory information, family and personal history of study participants

Characteristic	All (n=210)	Low risk for OSA (n=98)	High risk for OSA (n=112)	*P* value
Peak CK (ng/ml)	219.2 (28.2)	184.2 (32.7)	260.1 (36.9)	0.09
Cholesterol (mg/dl)	188.4 (21.9)	187.4 (20.2)	188.6 (24.3)	0.89
LDL (mg/dl)	118 (15.6)	121.6 (19.5)	115.2 (12.9)	0.40
HDL (mg/dl)	41.1 (18.5)	39.3 (15.6)	42.3 (20.3)	0.44
TG (mg/dl)	156.9 (24.6)	157.5 (28.5)	154.8 (28.3)	0.55
FBS (mg/dl)	130.5 (21.6)	120.8 (20.2)	139 (28.8)	0.03
Family history of MI	59 (34.7)	33 (40.2)	26 (29.5)	0.14
History of smoking	108 (52.9)	56 (57.1)	52 (49.1)	0.24
History of DM	30 (14.3)	15 (15.3)	15 (13.4)	0.69
History of HLP	29 (13.8)	16 (16.3)	13 (11.6)	0.32
History of HTN	27 (12.9)	14 (14.3)	13 (11.6)	0.56

OSA: Obstructive Sleep Apnea, CK: Creatine Kinase, LDL: Low-Density Lipoprotein, HDL: High-Density Lipoprotein, TG: Triglyceride, FBS: Fasting Blood Sugar, MI: Myocardial Infarction, DM: Diabetes Mellitus. Lab data are presented as mean (standard deviation) Family and personal history are presented as number (percent)

In current study, none of the demographic and anthropometric characteristics were significantly associated with OSA whereas Fumagalli et al. reported that BMI is a risk factor for OSA in patients with acute MI (12). In present study, among biochemical tests' data, only FBS had independent association with OSA. These findings are consistent with studies of patients with MI (21). In Lee et al. study, participants with DM were at higher risk of OSA and DM was a predictor of OSA in patients with MI (13). Experimental studies about underlying pathophysiological mechanisms of the association between OSA and DM in humans and animals have shown that intermittent hypopnea and reduced sleep duration adversely affect glucose metabolism (22).

Investigating the link between the onset of MI and OSA probability, this study had similar findings with Kuniyushi et al. and Gami et al. whose studies found that circadian pattern in the onset of MI is different among patients with or without OSA (23,24). From the midnight to 6 am, MI was significantly more in patients with OSA than those without OSA. Conversely in Aboyans et al. study circadian pattern in the onset of MI was totally different between patients with or without OSA; the frequency of MI was higher in OSA patients from 6 am to noon and higher in non-OSA patients from midnight to 6 am (15). Ludka et al. in a study among 782 patients with acute MI found that the diurnal variation in the onset of MI in OSA patients is similar to that observed in non-OSA patients. They indicated a peak in MI from 6 am to noon in both OSA and non-OSA patients (25).

Several limitations could be mentioned for this study. As a main limitation, we applied the STOP-BANG questionnaire for finding patients at high risk for OSA and the patients did not undergo PSG as a gold standard test for diagnosis of OSA. Another limitation was the uncertainty of patients for identifying the exact timing of the onset of the MI.

In conclusion, we report a high proportion of patients at higher risk for OSA among those admitted for acute myocardial infarction. Higher FBS could be a predictor of OSA among these patients. Onset of MI in midnight to 6 am was significantly more in patients at higher risk of OSA.

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