SciMedCentral

Annals of Nursing and Practice

Research Article

Severity of Stenosis and Obstructive Sleep Apnoearisk Factors, Symptoms in Patients Admitted to Coronary Angiography

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Submitted: 10 October 2017

Accepted: 31 January 2018

Published: 02 February 2018

ISSN: 2379-9501

Keywords

- Obstructive sleep apnea syndrome
- Risk factors
- Coronary angiography

Abstract

Obstructive sleep apnea (OSA) is risk factor for coronary artery atherosclerosis. OSA and its risk factors evaluation isn't carried out routinely with the patients hospitalized on suspicion of coronary artery disease. Thus, the aim of this study was to examine the prevalence and risk factors of obstructive sleep apnea syndrome and whether OSA risk factors and symptoms has any association with severity of stenosis. In a cross-sectional design, we collected data of 400 patients patients who underwent Percutaneous Coronary Intervention. To determine the obstructive sleep apnoea syndrome risk, the STOP-BANG were administered. Excessive daytime sleepiness was defined by a score ≥10 on the Epworth Sleepiness Scale. A*ngiographic data* obtained from coronary angiography' results of hospitals. Ethical approval was obtained for the study. Statistical analyses were performed using SPSS 20.0. Results were evaluated at 95% confidence interval and at $p<0.05$ significance level.

The neck circumference size was ≥43cm in 18.5% of men, ≥38 cm in 66% of women. The mean age of them was 60.45±1.40, the mean of body mass index was 28.08±4.7. Normal *coronary angiograms* were obtained for 101patients. Over and half of the participants had OSA risky. In parallel with OSA risky, it was determined that vessel lession risk increased. According to the logistic regression analysis, risk factors of vessel obstruction were age, neck circumference, cigarette, male gender, hypertension and obesity.

Conclusion: OSA risky is common in patients admitted to coronary angiography. There are association between OSA symptoms, presence of OSA risky and severity of stenosis.

ABBREVIATIONS

OSA: Obstructive sleep apnea: CAD: Coronary artery disease BMI*: Body mass index* ESS: Epworth sleepiness scale

INTRODUCTION

Obstructive **s**leep apnea is characterized by intermittent hypoxia during sleep [1]. OSA is a medical condition affecting approximately 2-14% of the general population, but is often undiagnosed. It is potentially life threatening and can have serious consequences for a patient's health [2-4]. Different studies have shown that OSA may be a risk factor for the incidence of some medical conditions such as *cardiovascular diseases* and stroke [1-4]. Studies indicate that coronary artery disease (CAD) is the leading cause of death among adults [4]. OSA is especially a major risk factor for *cardiovascular diseases [1,4-12].* In a *meta-analysis*, Loke and colleagues (2012) find that OSA *has* been associated with *cardiovascular* morbidity. They reported an approximately 2.09 (95% CI, 1.20–3.65) times increased risk of *cardiovascular* mortality due to severe OSA. In a similar study, the authors investigated that the risk of cardiovascular diseases was increased 2.49 (95% CI, 1.98–3.10) times with OSA [14]. It was stated in the study of Yumino et al., (2007) that co-morbidities of OSA and acute coronary syndrome is 57%. Javadi et al., (2014) study showed that the number of stenotic vessels was significantly higher in patients with OSA. Patients with OSA had more severe stenosis and a higher number of vessels involved [15].

Cardiovascular complications induced by *intermittent hypoxia in OSA*. The *relationships* between OSA and CAD are explained with the increase in sympathetic activation, increase in the level of hyperleptinemia, angiotensin II and aldosterone, the increase in hypercoagulability. At the same time, possible mechanisms of vascular complications in *OSA* are explained with oxidative stress, inflammation and endothelial dysfunction [1,3,5,16,17].

Obstructive sleep apnea is associated with multiple major CAD risk factors as male gender, BMI >30kg/m^2, cigarette smoking and alcohol consumption, but OSA is also an independent risk factor for CAD. Other important risk factors for OSA include large

neck circumference, *family* history and co morbidities such as hypertension, diabetes [2,3,16,18-22].

Despite their high prevalence, sleep disorders often remain unrecognized and untreated because of barriers to assessment and management [23]. Early recognition and treatment of OSA is important to prevent of *cardiovascular complications*, it has not yet been integrated into formal cardiovascular risk assessment algorithms. OSA evaluation isn't carried out routinely in patients hospitalized *due to suspected* coronary artery disease [3,7,9,15,18]. Also, there is little information in literature about the frequency of OSA in patients *undergoing coronary angiography*, who have in patients with *acute coronary syndrome [5,15].*

Polysomnography accepted for the final diagnosis of OSA is seen as an expensive and time-consuming method. Therefore, it is impossible to proceed with polysomnography for all the patients *undergoing coronary angiography*. The STOP-Bang questionnaire is a validated screening tool for OSA [2,7,8,24]. It is applied in community-based and clinical samples worldwide. However, this study is one of the few studies carried out to determine the risk and symptoms of OSA in patients *undergoing coronary angiography* using the STOP-Bang questionnaire [8,24]. Yantis & Neatherlin (2005) reported that one of the first steps in identifying OSA is to recognize its signs and symptoms. The *symptoms* of OSA are snoring and excessive daytime sleepiness (ESS). A multidisciplinary approach is needed to evaluate the patients and other individuals in the society in terms of the risks of many diseases [11,26]. *Nurses* are an important *member of the healthcare team. Nurses* can help identify patients likely to be suffering from this disorder [26]. Malcom reported (2005) a nurse's understanding of the condition, its diagnosis and treatment may help patients to manage it while in hospital.

Aim

The aim of this study was to examine the prevalence and risk factors of obstructive sleep apnea syndrome and whether OSA risk factors and symptoms has any association with severity of stenosis in patients admitted for percutaneous coronary intervention.

MATERIALS AND METHODS

According to the pre-study conducted with 20 people, GPower version 3.0.10 analysis was carried out and the number of the patients was determined as at least 153 for the sample size necessary for 80% power and at least α=0.05 significance level when a relationship between *body mass index* (BMI) and the number of involved vessels at the level of 0,20 was taken into consideration. Research sample was constituted by 400 patients (141 men and 259 women) admitted to the Hemodynamic Laboratory of the University Health Application and Research Center for coronary angiography between 01.03.2014 and 30.06.2014.

Criteria for inclusionin the study:

- Being admitted for coronary angiography
- Being 20 years old or more
- Not having a cardiac inflammation for at least 4 weeks and/or being in a stable period
- Having cognitive competence
- Being literate
- Being able to haveweight and height measured while standing.
- Voluntarily taking part of the study

Data collection tools

Patient Information Form included the socio-demographic characteristics of the patients, some OSA risk factors (neck circumference, history of sleep apnea in the family, body-mass index etc.), and angiographic results of the patients. A*ngiographic data* obtained from coronary angiography' results of hospitals. Angiographic results of the patients taking part in this study were evaluated by taking the opinions of the experts in 5 categories (Normal; Lesion without anycritical stenosis; Stenosis below 60%, Single-vessel lesion; Stenosis more than 60%; Two-vessel lesion; Three or more vessel lesion).

The symptoms and risky of OSA was evaluated using the epworth sleepiness scal**e** and STOP Bang Questionnaire. Excessive daytime sleepiness is daytime symptoms of OSA. The ESS was used subjective measure of sleepiness. ESS is an eight-item questionnaire that is a simple and inexpensive instrument. The cut off point for excessive daytime sleepiness is considered to be equalor greater than 10 [11]. The STOP-Bang questionnaire consists of eight dichotomous (yes/no) items related to the clinical features of sleep apnea (Snoring, tiredness, observed apnea, high blood Pressure, BMI, age, neck circumference and male **g**ender). STOP-Bang screening tests have a high sensitivity (>90%) to determine of OSA risky. The total score ranges from 0 to 8 [24].

Data collection

Research data was collected by the researcher through face-to-face interview method at Hemodynamic Clinicof the University Health Application and Research Center between March 2014 and June 2014.

Analysis

During the evaluation of data, SPSS 20 (Statistical Package for Social Sciences PASW Inc., Chicago. IL.USA) was used for statistical analysis. Help was received from a statistics expert. Results were evaluated at 95% confidence interval and at $p<0.05$ significance level.

Data about the descriptive characteristics of the patients (except for age), the clinic characteristics of the patients and about the angiographic results of the patients were given as number and percentage. Age, which was a continuous variable, was presented with mean and standard deviation. The difference between the state of daytime sleepiness of the patients according to their descriptive characteristics and OSA risk evaluation carried out through STOP Bang Questionnaire was evaluated with chi-square analysis. When the expected value was less than 5, one-sided

significance value was taken into consideration. When two-sided significance value was asked, Fisher-Freeman-Halton test was taken into consideration. Change between angiography results according to OSA indicators was analyzed through the Fisher-Freeman-Halton test. The relationship between the angiographic results of OSA risk factors was tested through Logistic Regression Analysis. The patients were divided into two groups according to the angiography results for logistic regression analysis: "0"=no stenosis and "1" = any stenosis or lesion.

Ethical aspect of the study

A written permission was sought from the Uludağ University's Faculty of Medicine Hospital, where the study was conducted, in order to conduct this study.The approval of the ethics committee was gotten from the Ethics Board of the Non-Pharmacological Clinical Researches, Faculty of Medicine (2014-7/11). Written consent was gotten from all the patients participating in this study.

RESULTS

Table 1 includes the descriptive characteristics of all the participants. Participants' mean age was 60.45±11.40, almost all (93.5%) of the participants were married, nearly half (48.5%) of the participants had primary school education and nearly one fifth (18%) of the participants had university degree. When the participants are grouped in terms of their job status, it is seen that nearly half (41.8%) of the participants are not working, 28.2% of participants are housewives, 17.5% of the participants work in a sedentary job, and 12.5% of the participants work in a non-sedentary job.

Table 2 includes information about angiography findings, *symptoms* of OSA and evaluation of risk for *OSA* according to the STOP Bang Questionnaire. According to the STOP Bang Questionnaire, 275 participants (68.8%) have a high risk of OSA, 111 participants (27.7%) have a low risk of OSA, and 14 participants (3.5%) have no risk of OSA. According to Epworth Sleepiness Scale, 348 participants (87%) don't have a condition of daytime sleepiness and 52 participants (13%) have a condition of daytime sleepiness. According to the angiography results, 101 participants (25.2%) don't have any stenosis in their coronary vessels, 117 participants (29.2%) have lesion in their coronary vessels but the stenosis in their vessels is not critical (below 60%), 97 participants (24.3%) have lesion in only one of their coronary vessels and the stenosis is more than 60%, 22 participants (5.5%) have lesion in two of their coronary vessels, and 63 participants (15.8%) have lesion in three or more of their coronary vessels.

Table 3 includes information about the distribution of sleep apnea risk factors in patients. The mean BMI of the patients was 28.08±4.74, 23.5% of the patients were obese and 50% of them were overweight (BMI 25 – 29.9). The mean neck circumference was 40.15± 3.5 cm for men. The neck circumference of 48 men (18.5%) was ≥43cm and neck circumference of 211 men (81.5%) was below ≤42 cm. The mean neck circumference was 38.96 ± 3.16 cm for women. When the participants were asked whether they drank alcohol or smoked, 346 participants (86.5%) stated that they didn't drink alcohol, 294 participants (73.5%) stated that they didn't smoke. Of these 400 patients, 44 patients stated that they drank 2 glasses of alcohol or less in a week. 88 (22%) of the participants stated that they were active smokers, and 18 (4.5%) of them stated that they were ex-smokers. 380 patients (95%) in this study stated that they didn't have a history of sleep apnea in their family, and 20 patients (5%) stated that they had a history of sleep apnea in their family.

Older age, male gender high BMI and large NC was significantly associated with OSA risk level (Table 4).

Table 1: Distribution of the patients according to their descriptive characteristics.

Age (mean±s.deviation)	60.45±11.40
Gender n (%)	
Male	259(64.8%)
Female	141(35.2%)
Marital status (n%)	
Married	374(93.5%)
Single	26(6.5%)
Educational status (n%)	
Literate	25(6.3%)
Primary School	194(48.5%)
High School	109(27.2%)
Higher Education and above	72(18.1%)
Job status (n%)	
Not working	167(41.8%)
Housewife	113(28.2%)
Sedentary Job*	70(17.5%)
Non-Sedentary Job**	50(12.5%)

*civil servant, shopkeeper, driver and others
**worker, farmer

Table 2: OSA risk and symptoms in patients admitted to coronary angiography.

STOP-Bang questionnaire	**n(%)**
No Risk	14(3.5%)
Low Risk	111(27.7%)
High risk	275(68.8%)
Snoring	
Presence	302(75.5%)
Absent	90(22.5%)
Unknown	8(2%)
Excessive daytime sleepiness	
Presence (ESS score ≥10)	52(13%)
Absent	348(87%)
Witnessed apnea	
Presence	9(22.5%)
Absent	309(77.5%)
Angiography results	**n (%)**
Normal	101(25.2%)
Having lesion but no critical stenosis (stenosis below 60%)	117(29.2%)
One vessel lesion. Stenosis more than 60%	97(24.3%)
Two vessels lesion	22(5.5%)
Three or more vessels lesion	63(15.8%)

Table 3: Sleep apnea risk factors in patients.	
BMI (kg/m2) (mean±s.deviation)	28.08±4.74
BMI group	**n (%)**
< 24,9kg/m^2	106(26.5%)
25-29,9	200(50.0%)
> 30	94(23.5%)
Neck circumference, men (mean±s.deviation)	40.15± 3.5
Neck circumference, women (mean±s.deviation)	38.96 ± 3.16
Neck circumference,male	**n(%)**
≥43cm	48(8.5%)
≤42cm	211(81.5%)
Neck circumference, female	
≥38cm	93(66.0%)
≤37cm	48(34.0%)
Amount of the alcohol consumed	
No alcohol consumption	46(6.5%)
≥2 glasses alcohol in a week	52(13.5%)
Smoking	
Never smoke	94(73.5%)
Ex-smoker	18(4.5%)
Active smoker	88(22.0%)
***Family* history**	
Yes	20(5.0%)
No	380(95.0%)

Table 4: Sleep apnea risk factors and OSA risk level according to STOP-Bang questionnaire.

	No risk	Low Risk	High Risk	P
Age[Medyan (min-maks)]*	46 (23-769)	57(33-86)	63(30-87)	**<.001**
Gender**				
Female Male	13 (%.2) 1 (%0.4)	47 (% 33.4) 64 (%24.7)	81 (%57.4) 194 (%74.9)	**<.001**
BMI**				
< 24,9 25-29,9 > 30	1 0 (%9,.4) 53 (%1.9) 1 (%0.8)	55 (%51.9) 44 (%27.2) 12 (%9.81)	41 (%38.7) 115 (%71) 119 (%90.2)	**<.001**
Neck Circumference*	40.77±0.19	37.63±0.22	35.92±0.84	**<.001**

*KruskalWallis test, **Pearson chi-sguare

Regarding the comparison of the risk of OSA according to the STOP Bang with angiographic findings, significant association was observed (p=<.001) (Table 5). There was a parallel increase between OSA risk level and vessel lesion number. Vessel lesion rates *were significantly higher* in p*atients with high risk OSA than* in *those without*. 88.9% of patients with three or more vessels lesion, 100% of patients with two vessel lesion, 86.6% of patients with one vessel lesion, 66.6% of patients with *no critical stenosis has high risk for OSA.*

A significant relationship was found between snoring, *witnessed apnea* and angiographic findings (p≤0.001). The snoring and *witnessed apnea* group had high vessel lesion ratios (p = 0.001; Table 5).

In the logistic regression analysis (Table 6), the independent risk factors related to high risk for vessel lesion were age (1.068), neck circumference (1.112 times greater chance), hypertension (3.023 times greater chance of presenting high risk for vessel lesion) and male gender (3.443 times greater chance). Also, The presence of vein occlusion in those whose body mass index are between 25-29.9 increases 1.997 (95% CI 1.059-3.766) times compared to those whose BMI are ≤24.9, and it increases 3.071 (95% CI 1.431-6.593) times in those whose BMI are ≥ 30.

DISCUSSION

The World Health Organization reported that 31% of all global deaths was linked to cardiovascular diseases (28). OSA is risk factor for CAD [1,4,5,7-12]. OSA is frequently underdiagnosed and thus undertreated in CAD [2,4,6,7]. Hein, Loo and Lee (2012) stated OSA can trigger worse cardiovascular outcomes in patients and it is imperative identification of OSA in acute coronary syndrome patients. It is important before *coronary angiography* the determine of OSA risk as the syndrome has a deleterious effect on many of the organ systems especially the cardio-respiratory system [3,7,9,15,18]. Polysomnography is deemed the *gold standard* to diagnosing of OSA [13,29]. It is *impossible* to use in screening of all patients affected by cardiovascular disease *of the polysomnogram* test. STOP Bang questionnaire was a *suitable* screening tool for determine patients with unrecognized OSA [2,7,8,29]. *Researchers* reported the negative predictive value of the STOP-Bang model for OSA risky was high, especially in patients with moderate to severe OSA [2,7,8,24]. The STOP Bang Questionnaire has a high *sensitivity* in determining OSA risky for Turkish population [24]. OSA risk assessment has not yet been integrated into formal cardiovascular risk assessment algorithms. Also, in all patients undergoing *coronary angiography* didn't perform routine screening for OSA risk. In our study, according to the STOP Bang Questionnaire, 68.8% of the patients have a high risk to OSA. It can be said that the participants in our study have *a high* risk *for* OSA.

The prediction of *high* OSA risk in our patients were *supported by* finding shows *most patients in our study have snoring*. Earlier studies suggested that *snoring,* witnessed apnea and excessive daytime sleepiness are an *important* clinical *symptoms* of *OSA [2,30].* In our study, of the 400 patients, 302 (75.5%) had snoring. 13% of the patients have daytime sleepiness that is one of the major symptoms of OSA. Also, 22.5% of the patients has witnessed apnea. At the same time, a statistically significant difference was found in our study between the evaluation of OSA risk through the STOP Bang Questionnaire, snoring-obstruction and angiographic findings. We can say identification of OSA risk is especially important to prevent cardiovascular complications in these patients. *We found* patients had *low* excessive daytime sleepiness (ESS score ≥10) *rates* (13%). *The reason for this result can* be *explained* by OSA is not the only cause for excessive daytime sleepiness. In Study of Drager et al., (2010) reported 51% of Patients with OSA had no excessive daytime sleepiness. We can say the STOP Bang Questionnaire should perform in before *coronary angiography* for prevent of deleterious effect of OSA. Later, polysomnography can applied the patients if OSA risk was high.

Table 5: Relationship between OSA risk, symptoms and severity of stenosis(n,%)*.

STOP-Bang questionnaire				
	No risk	**Low Risk**	**High Risk**	**p**
Normal vessel	13(12.9%)	53(52.4%)	35(34.7%)	
Lesions with *no critical stenosis*	1(0.9%)	38(32.5%)	78(66.6%)	
One vessel lesion	0(0.0%)	13(13.4%)	84(86.6%)	
Two vessels lesion	0(0.0%)	0(0.0%)	22(100%)	**<.000**
Three or more vessels lesion	0(0.0%)	7(11.1%)	56(88.9%)	
Snoring				
	Absent	Presence	Unknown	
Normal vessel	53(52.5%)	46(45.5%)	2(2.0%)	
Lesions with *no critical stenosis*	3(2.6%)	90(76.9%)	3(2.6%)	
One vessel lesion	7(7.2%)	89(91.8%)	1(1.1%)	
Two vessels lesion	2(9.1%)	20(90.9%)	0(0.0%)	**<.000**
Three or more vessels lesion	4(6.3%)	57(90.5%)	2(1.2%)	
Excessive daytime sleepiness n(%)				
	Absent	Presence		
Normal vessel	93(92.1%)	8(7.9%)		
Lesions with *no critical stenosis*	106(90.6%)	11(9.4%)		
One vessel lesion	81(83.5%)	16(16.5%)		
Two vessels lesion	17(77.3%)	5(22.7%)		**<.000**
Three or more vessels lesion	51(81.0%)	12(19.0%)		
Witnessed apnea				
	Absent	Presence		
Normal vessel	3(3%)	98(97%)		
Lesions with *no critical stenosis*	16(13.7%)	101(86.3%)		
One vessel lesion	36(37.1%)	61(62.9%)		
Two vessels lesion	6(27.3%)	16(72.2%)		**<.000**
Three or more vessels lesion	30(47.6%)	33(52.4%)		

* Fisher-Freeman-Halton test was used in the comparisons. Column percent was used.

Table 6: The relationship between OSA risk factors and coranary lesions according to Logistic regression analysis.

	B	**S.E.**	**Sig.**	**OR**	**95% C.I.for EXP(B)**	
					Low	**High**
Age	0.066	0.014	**0.000**	1.068	1.040	1.097
Male	1.236	0.321	**0.000**	3.443	1.837	6.453
Neck Circumference	0.106	0.046	**0.022**	1.112	1.016	1.218
BMI < 24,9			0.129			
BMI 25-29,9	0.489	0.330	**0.139**	1.631	0.854	3.115
BMI > 30	0.792	0.404	**0.050**	2.207	1.000	4.868
Drinking Alcohol	-0.246	0.482	0.611	0.782	0.304	2.013
Smoking			0.060			
Stopped Smoking	0.474	0.765	0.536	1.606	0.358	7.192
Actively Smokers	1.371	0.813	0.092	3.941	0.801	19.386
Family history (yes)	0.411	0.746	0.582	1.508	0.349	6.505
Hypertension (Yes)	1.106	0.306	**0.000**	3.023	1.660	5.505

B: Coefficient; SE:Standard Error ; OR:Odds Ratio *CI*:Confidence interval

OSA risk level of the patients determined through the STOP Bang Questionnaire and stenosis severity were compared in our study. OSA is thought to have increased the possibility of coronary lesion by inducing inflammation, oxidative stress and endothelium damage [5,9]. We found the risk of OSA among patients with the vessel lesion is extremely high. A *minority of the patients* having a high risk for OSA had normal vascular structure. *Also, 47.6% of patients with witnessed apnea has three or more vessel lesion. In our study, 3%* of *vessels were normal conditions.*

These results are compatible with the information in literature revealing that there has been a relationship between OSA and cardio vascular diseases. The relationship between OSA and coronary artery disease has been proven in several studies [1,5,9,13,14,19,32]. Javadi et al., (2014) in their study found a strong correlation between the number of stenotic vessels and OSA. Also, Javadi et al., (2014) determined in their study that there are 2 to 3 vessels stenosis among high-risk patients for OSA as classified by Berlin questionnaire. Liu et al., (2014) stated in

their study that the severity or degree of *stenosis* in patients with OSA appeared to be higher than that of non-OSA patients. Also, in their study, The incidence of 3-vessel disease was higher in the OSA group. Unlike of our study, they reported the proportion of patients with double vessels disease was higher in non-OSA group. It should be noted that, in the of study, the prevalence of OSA is evaluated objectively using PSG, although, there are results that highlight the reliability of the subjective measurement obtained through the STOP bang [2,12,24]. In addition, their study included patients with ST-Elevation myocardial infarction [9], in our study, ppatients hadn't cardiac *exacerbations. Also, Acar et al.*, (2013) found the sensitivity of STOP Bang was 96.9% to *detect sleep apnea* (*AHI* ≥ 30*). It is important to note that,* it is essential for the healthcare team to be familiar with OSA risk for patients undergoing cardiac surgery.

There are mutual risk factors for cardiovascular diseases and sleep apnea syndrome. The important risk factors are age, gender, obesity, high blood pressure, smoking and alcohol consumption [1,8,21,31-35]. Also, neck circumference is risk factor both of them [28,33,35]. From logistic regression analysis, the variables age, gender (man), >30 BMI, NC and hypertension were found to be significant at 5 percent level of significance in our study. There was more observed vein occlusion if higher the odds ratio. It was observed high odds ratio for man gender (3.44, 95%CI, 1.04-1.09), hypertension (3.02, 95%CI, 1.66-5.50), >30 BMI (2.20, 95%CI, 1.00-486), NC (1.11, 95%CI, 1.66-5.50), *respectively.*

Age and obesity have similar mechanisms on vascular structures [36,37]. *They are* causing decrease in elasticity and an increase in stiffness of the arterial system. The *changes* in cardiovascular system are increased vessel occlusion [36]. Having *high neck circumference* was associated with obesity and CVD mortality [38]. Dai et al., (2016) reported that neck circumference is associated with development of cardiovascular disease in population study. Also, older age, higher NC and obesity are risk factors for sleep apnea syndrome [10,26,28,30,31-34,37,38]. It was determined in our study that there is a significant relationship between the age, higher NC and BMI of participants and OSA risk level according to the STOP Bang Questionnaire.OSA has *similar* effects on endothelial function and arterial stiffness such as a*geing, obesity* [37].

There are several autonomic and hemodynamic changes in sleep apnea that may play a role in the pathogenesis of hypertension development. *Increase* of CO_2 (Carbon dioxide) retention and decrease in oxygen saturation due to intermittent hypoxia *can be a cause of changes* in autonomic and hemodynamic response [1,3,31]. The possible mechanism between OSA and hypertension is explained with the increase in sympathetic activation, increase in the level of hyperleptinemia, angiotensin II and aldosterone, the increase in hypercoagulability, with oxidative and inflammatory stress, with endothelial dysfunction, and with baroreflex function due to intermittent hypoxia [1,17]. Changes in blood pressure occur as a result of increase in sympathetic activity and the secretion of vasoconstrictive substances such as endothelin. At the same time, oxidative stress and endothelial dysfunction caused by OSA play a role in vascular complications [1,3,5,17,37]. Eventually, hypertension *increases* the risk of the development of cardiovascular disease such as ischemic heart disease [39]. It was determined in our study that according to regression analysis results, the risk for vein occlusion in the patients with hypertension is 3.023 (95%CI 1.660-5.505) times more. It was determined in our study that the risk for vein occlusion in those whose BMI was between 25 and 29.9 increased 1.997 (95%CI 1.059-3.766) times compared to those whose BMI was ≤24.9, and it increased 3.071 (95%CI 1.431-6.593) times in those whose BMI was ≥30. It can be said that the risk of developing cardiovascular disease is higher in elderly and obese individuals with OSA risk**.** We can say that elderly, hypertensive, obese individuals should be routinely screened for OSA. This approach, which will provide the identification of OSA, will be important in preventing the effects of OSA on the cardiovascular system and will enable more effective approaches to cardiovascular diseases.

Male gender is cardiovascular diseases and OSA risk factors [33,34]. Some studies reported that there are a number of pathophysiological differences to suggest why men are more prone to OSA and cardiovascular disease than women. Why Male gender is cardiovascular risk factors, it is explained by differences in body fat distribution, plasma lipoprotein levels and hormonal [18,21,34]. The male predisposition for OSA has been attributed to some factors including differences in breathing control, hormones and aging [18, 21]. Heinzer et al., (2015]. It was found in our study that there is a significant relationship between gender and OSA risk level determined by the STOP Bang Questionnaire, hence, 57.4% of the women and 74.9% of the men had high risk of OSA. Our findings support the view that male gender is a risk factor for OSA. It is also seen in a logistic regression analysis that male gender is a factor increasing OSA risk and vein occlusion.

Difficulties and limitations of the study

Our study has limitations that deserve attention. As the number of the patients was high, economic cost was high and time was limited, polysomnography, accepted as the gold standard in determining OSA, couldn't be performed. Thus, we could not determine the actual effect OSA on the development and severity of cardio-vascular diseases.The STOP Bang Questionnaire is a screening test for the high risk of OSA and should not replace a full OSA investigation [8,20,24]. In conclusion, STOP Bang test could be used to predict the presence of OSA risk in patients undergoing cardiac surgery.

This study was a cross-sectional retrospective. Thus, generalisation of findings to another people, to populations with a high prevalence of cardio-vascular diseases, or to patients admitted for percutaneous coronary intervention is limited.

CONCLUSION AND SUGGESTIONS

According to the STOP Bang Questionnaire, more than half of the patients undergoing percutaneous intervention having a high risk for OSA, the possibility of having vessel lesion in the coronary arteries of the patients with high risk for OSA being quite high. There are relationship important between older age,

male gender, obesity, larger NC, hypertension and OSA risk level according to the STOP Bang Questionnaire. The relationship between OSA symptoms and vein occlusion are dramatic results of our study.

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Cite this article

Köz S, Güneş Z (2018) Severity of Stenosis and Obstructive Sleep Apnoearisk Factors, Symptoms in Patients Admitted to Coronary Angiography. Ann Nurs Pract 5(1): 1090.