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Relationship Between Snoring and Pulmonary Complication After Coronary Artery Bypass Graft Surgery

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Abstract

Background: Obstructive sleep apnea and snoring are associated with high blood pressure, stroke, and cognitive impairment, as well as increased risk of perioperative heart events and respiratory failure.

Objective: This study aimed to investigate the association between snoring and pulmonary complications after coronary artery bypass graft (CABG) surgery.

Materials and Methods: In this cross-sectional study, 232 participants referred to two general hospitals in Mashhad, Iran, from December 2017 to January 2018, for coronary artery bypass surgery, were categorized into two groups of snoring and non-snoring history. A checklist including demographic characteristics, snoring history, medical history, lung complications, and laboratory findings was completed for each participant. In addition, three snoring questionnaires, including STOP-BANG, Berlin, and Epworth, were filled out.

Results: The results showed no statistically significant differences between the groups in terms of age (P=0.404). Moreover, there was a significant difference in oxygen saturation, duration of extubation, and length of stay in ICU and surgery ward in the snoring group. The mean score of the snoring group was significantly high according to the Epworth scale (P=0.001). According to the Berlin and STOP-BANG questionnaire, participants with snoring had a significant risk of apnea and obstructive sleep apnea with P=0.008 and P=0.001, respectively. There was no significant difference between the history of diseases, such as hypertension, diabetes, and hyperlipidemia (P>0.05).

Conclusion: conclusion: In CABG surgery patients, snoring increases the time required for extubation and the length of stay in hospital; it also decreases oxygen saturation after surgery.

Keywords: Coronary artery bypass graft surgery, Pulmonary complications, Snoring

Introduction

Chronic diseases account for 70% of mortalities in Iran, and cardiovascular diseases are responsible for 42% of these deaths. In this regard, coronary artery diseases are the leading cause of death (1) so that 1.5 million people die of myocardial infarction each year, and more than 600,000 deaths are attributed to its complications (2). Obstructive sleep apnea (OSA) and snoring are associated with an increased risk of hypertension, myocardial infarction, stroke, and abnormalities of perceptual abilities, as well as the risk of perioperative cardiac events and respiratory failure. Therefore, the analysis of related issues, especially snoring, is of great importance (3). The OSA is a type of sleep-disordered breathing associated with frequent upper airway obstruction during sleep due to pharyngeal airway collapse (4). The prevalence of OSA in the general population is linked to significant risk factors, including male gender, oldness, and obesity (5). As an independent risk factor for many cardiovascular diseases, OSA can increase mortality and morbidity rates (6). The cardiopulmonary complications, especially in the first post-operative stages, can be exacerbated due to the side effects of anesthetics and analgesics in controlling ventilator and respiratory muscle tone (7). In addition, sleep disorders, such as drowsiness and sleep deprivation, increase eye movements in the first post-operative days and may cause adversely affect respiratory and cardiac systems (8). The potential clinical complications of post-operative sleep disorders include airway collapse along with OSA, hypoxemia and hypercapnia aggravation, cardiac and ischemia arrhythmia, difficulty in airway management, encephalopathy, and increased post-operative infections (9-11). Accordingly, screening for OSA in patients undergoing elective heart surgery is recommended to reduce pre-operative risk and improve intraoperative management (12). Since most

patients with OSA are not diagnosed, they are at a higher risk during surgery. However, few studies have examined OSA in patients who were candidates for heart surgery, and the present study aimed to explore this subject. The main objective of this study was to determine the relationship between snoring and pulmonary complications after coronary artery bypass graft (CABG) surgery. Moreover, extubation time, oxygen saturation, and incidence of complications, such as pneumonia, pulmonary edema, pneumothorax after CABG surgery, and the number of vessels affected in angiography and heart valve disease, were compared in snoring and non-snoring participants.

Material and Method

In this cross-sectional study, 232 participants who were candidates for CABG surgery and referred to general hospitals affiliated with Mashhad University of Medical Sciences, Mashhad, Iran, from December 2017 to January 2018, were enrolled in two snoring and non-snoring history groups (n=116 in each group). Its notable that we used Target-based sampling.

The participants who had an infectious disease, a history of pneumonia or recent respiratory infection, recent trauma or surgery, lung cancer, mediastinal mass, severe asthma, cardiopulmonary resuscitation (CPR) during or after surgery, and the individuals who were scheduled for re-operation, were excluded from the study.

Data include age, gender, weight, height,6 month or longer history of snoring, heart disease, diabetes, hypertension, smoking, and addiction. Furthermore, the symptoms of common pulmonary disorders in chest X-ray (CXR) before surgery, the number of affected vessels in angiography, valvular disorders, and injection fraction in echocardiograph were collected from the participants' medical records. Afterward, Epworth and STOP-BANG questionnaires were completed separately for each participant.

Intraoperative data, such as the type of operation (on-pump or off-pump), length of operation, duration of cardiopulmonary bypass, the use of intra-aortic balloon pump, intraoperative transfusion, and the number of employed packed cells were also recorded. After CABG surgery, oxygen saturation (SpO2) and pulmonary complications, such as pneumonia, pulmonary edema, and pneumothorax, were recorded and followed until discharge (at least one week after surgery). The SpO2 was continuously monitored in the intensive care unit (ICU), was recorded at least eight times per day in the ward, and if patients had at least one episode of SpO2<90% for a minimum duration of one minute, it was recorded as low oxygen saturation. In addition, vital signs and arterial blood gas (ABG) parameters were recorded before, during, and after CABG.

STOP-BANG Questionnaire

This questionnaire includes eight items about gender, history of loud snoring, daytime drowsiness, respiratory failure during sleep, high blood pressure, being over 50 years of age, body mass index>35 kg/m^2, and neck size>40 cm, which assesses the risk of OSA as Yes (1) and No (0) (13).

Berlin Questionnaire

The Berlin Sleep Apnea Assessment Questionnaire consists of three sections and 11 questions. If the sum of items' scores is positive in each section or not positive at all, the risk of sleep apnea is low. Alternatively, if two or more sections are positive, the risk of sleep apnea is high (14).

Epworth Questionnaire

This questionnaire evaluates the patients' drowsiness. In the Epworth questionnaire, people score their usual chance of falling asleep or dozing off in eight different activities from 0 (no drowsiness at all) to 3 (most likely to no drowsiness). These daily activities include sitting and studying, watching TV, inactive sitting in a public place (e.g., a theater or a lecture session), sitting in a vehicle for one uninterrupted hour, lying down for an afternoon break, sitting and talking to someone, sitting quietly after lunch, and waiting at the traffic light for some minutes in the traffic. The respondents were asked to assess the effect of similar activities even if they had not performed some of the items mentioned above. The likelihood of drowsiness was rated from 0 to 24 after answering all questions and adding the overall "likelihood of drowsiness" score to obtain a unit number (15).

Ethical Consideration

The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (IR.MUMS.fm.REC.1396.536). All participants signed a written informed consent after the purpose and steps of the study were fully explained to them on the day before surgery.

Statistical Methods and Sample Size

According to Hwang D. et al. (16), considering the confidence level of 95% and the power of 80%, a sample size of n=116 was calculated for each group. Statistical analysis was performed using SPSS software (version 21) (IBM Armonk, NY, USA). In addition, variables were reported as number (percentage) or mean±standard deviation (SD). The Student's t-test or nonparametric Mann-Whitney test was used for quantitative data, and Fisher's exact

test was employed for categorical data. The normal distribution of data was assessed by the Kolmogorov-Smirnov test. Furthermore, an analysis of covariance was used to compare the values of the two groups, namely pre-intervention and post-intervention, and repeated measurement was also utilized in this study. Furthermore, a p-value less than 0.05 was considered statistically significant.

Results

Among 244 participants who were initially enrolled in this study, four cases died (during the operation or in the early hours after the operation), and eight patients were excluded due to the need for re-operation. Finally, 232 patients (70 females and 163 males) with a mean age of 61.75±8.87 years were enrolled in this study as divided into snoring and non-snoring groups (n=116 in each group). The two groups were analogous in terms of medical history and age (Table 1). According to the results, the maximum systolic blood pressure during the operation was 143.47±17.80 in snoring and 144.16±18.74 in non-snoring groups (P=0.774). In addition, there was no significant difference between the two groups in vital signs during surgery.

Before and after the operation, the laboratory indices were not significantly different between the two groups (Table 2). The results revealed that oxygen saturation was significantly lower in the snoring group than in the non-snoring group. Moreover, extubation period, ward hospitalization, ICU admission, probability of OSA and apnea, as well as drowsiness were higher in the snoring group than in the non-snoring group; however, no significant difference was observed between the groups in terms of the drainage volume (Table 3). In total, there were five cases of pneumonia, three of which reported snoring, and two cases were in the non-snoring group. Moreover, two cases of atelectasis were detected by CXR, one of which had snoring. Furthermore, no case of pneumothorax was found in any of these groups. The results of the repeated measurement test indicated that in the variables related to ABG, before and during surgery and in ICU, there was no significant differences in PH (P=0.314), partial pressure of oxygen (P=0.707), partial pressure of carbon dioxide (P=0.312), bicarbonate (P=0.974), BE (P=0.397), glucose (P=0.917), and lactate (P=0.621). The mean prothrombin time during discharge in snoring patients (14.33±2.63) was not significantly different from non-snoring cases (14±2.33) (P=0.543). In addition, there was no significant difference in the international normalized ratio (P=0.729). The results of the present investigation suggested that SpO2 in the ICU was not significantly different between the two groups (P=0.722). However, in the ward, SpO2 was lower in the snoring group than in the non-snoring group . (P=0.008) decrease in oxygen saturation was more pronounced in the snoring group. Table 3 indicates the post-operative clinical findings in the two groups.

The mean score of the Epworth questionnaire was significantly higher in the snoring group than in the non-snoring group (7.01±3.15 versus 52.23±6.19, P<0.001), which suggests a higher likelihood of drowsiness in the snoring group. According to the STOP-BANG questionnaire, the snoring group was significantly more at risk for OSA (P=0.001) (Figure 1). Moreover, according to the Berlin questionnaire, the risk for apnea is significantly higher in the snoring group (P=0.008) (Figure 2).

Table 1. Demographic characteristics of the participants in the studied groups (n=116 in each group)

Variables	Snoring Group	Non-snoring Group	P-value
Age*(Mean±SD)	61.88±11.93	63.14±10.95	0.404
GenderMales**	92 (79.3%)	72 (62.1%)	0.003
Body Mass Index*	25.71±3.77	27.31±12.42	0.187
History of Hyperlipidemia**	23 (19.8%)	26 (22.4%)	0.374
History of Diabetes**	42 (36.2%)	46 (39.7%)	0.342
History of Hypertension**	87 (75%)	91(78.4%)	0.321
History of Smoking**	19 (16.4%)	21 (18.1%)	0.431
History of Addiction**	31 (26.7%)	37 (31.9%)	0.235
Acute Renal Failure	3.4%	0	0.639

*Data presented quantitatively (independent t-test)
**Data presented as categorized data (Chi-square test)
COPD: Chronic Obstructive Pulmonary Disease

Table 2. Comparison of pre-operation and post-operation laboratory findings in the two studied groups (n=116 in each group)

Groups Variables	Snoring Group	Non-snoring Group	P-value
Preoperative Hemoglobin	12.75±2.40	12.67±2.49	0.793
Postoperative Hemoglobin	11.02±1.64	11.21±1.78	0.389
P-value**	<0.001	<0.001	
Preoperative Hematocrit	38.48±6.02	38.32±6.29	0.848
Postoperative Hematocrit	39.62±4.01	35.25±5.94	0.358
P-value**	0.7	0.7	
Preoperative Blood Urea Nitrogen	39.99±17.93	41.03±18.93	0.672
Postoperative Blood Urea Nitrogen	42.18±18.48	42.45±20.03	0.916
P-value**	0.2	0.5	
Pre-operative Platelet	230.80±43.46	227.01±46.14	0.524
Postoperative Platelet	166.87±46.32	164.88±50.26	0.754
P-value**	<0.001	<0.001	
Pre-operative Blood Glucose	128.11±47.79	130.78±52.15	0.687
Postoperative Blood Glucose	141.51±50.66	140.13±46.62	0.832
P-value**	0.02	0.1	
Preoperative Creatinine	1.43±1.57	1.56±1.82	0.578
Postoperative Creatinine	1.28±0.84	1.30±0.83	0.879
P-value**	0.2	0.09	---

Data presented as mean±SD.
* Comparison of pre-operative and post-operative changes in each group
** Comparing the pre-operative and post-operative changes in the two groups

Table 3. Post-operative clinical findings for the two studied groups (n=116 in each group).

Variables	Snoring Group	Non-Snoring Group	P-value
Extubation Time (h)	7.69±3.29	6.88±2.33	0.037
Volume of Drainage	107.69±79.02	111.53±77	0.481
Length o Stay in the ICU (Day)	3.91±0.75	3.22±0.84	0.001
Length of Stay in the Ward (Day)	2.32±0.52	2.13±0.47	0.005

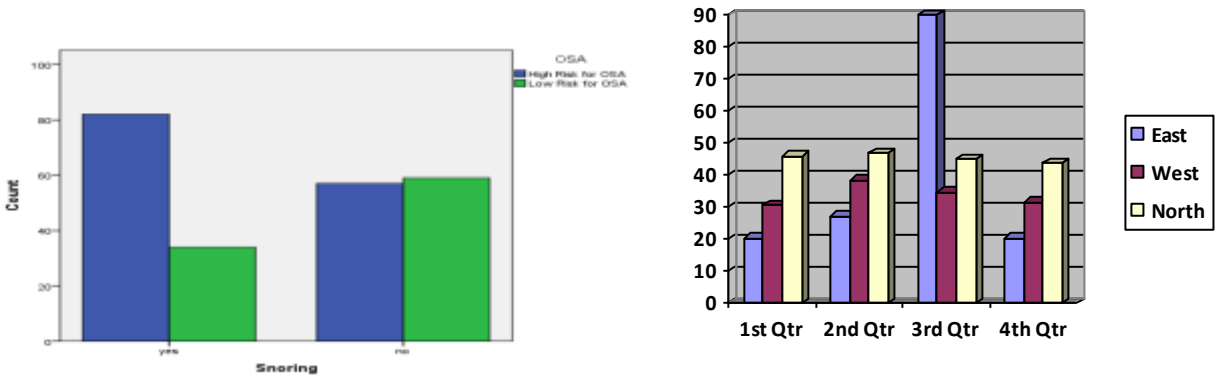

Figure 1. Differences between the number of subjects at high risk for OSA according to the STOP-BANG questionnaire score in the two study groups

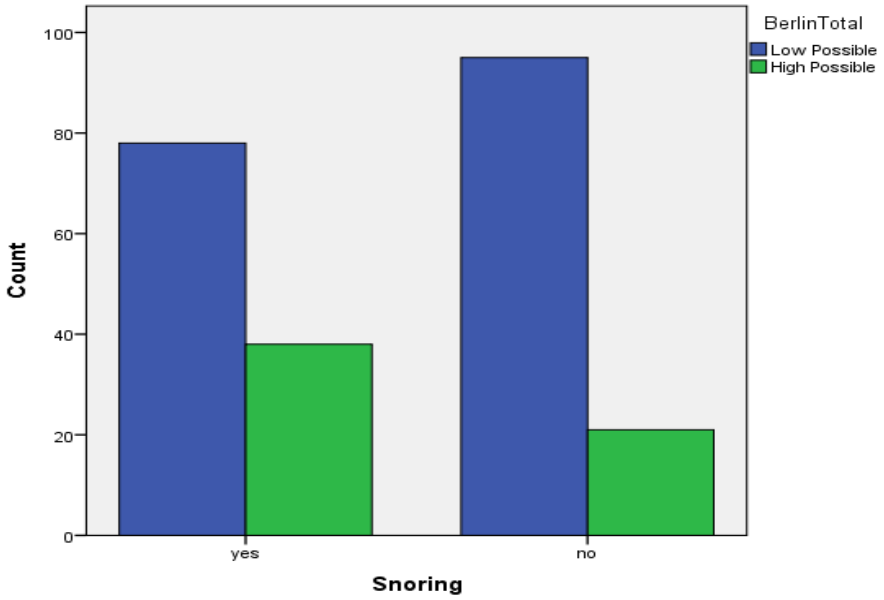

Figure 2. Differences in the number of subjects at high risk for apnea according to the Berlin questionnaire score in the two study groups

Discussion

The results of the present study revealed no significant difference between the two groups in terms of pulmonary or cardiac complications and CXR disorders. However, intubation time and length of hospital stay were significantly higher in the snoring subjects than in non-snoring ones. Moreover, snoring subjects were more likely to have apnea based on the Berlin questionnaire and OSA based on the STOP-BANG questionnaire.

Snoring has been documented in numerous cases of heart disease. In recent years, several studies have been conducted to investigate the role of sleep disorders and snoring as an influential factor associated with heart disease. Several investigations indicate that apnea is more common in the first weeks after the onset of acute heart problems (17). The authors observed the same pattern in the participants of the present study. Most studies reported a close relationship between drowsiness and sleep apnea, which was also evident in the present investigation. Allexopolous et al. reported that sleep apnea is closely connected to daytime drowsiness, meaning that apnea is associated with a greater rate of drowsiness (18).

In 2015, Kua et al. studied 150 patients who were candidates for elective CABG in terms of apnea and reported a 22.7% incidence of acute renal failure after CABG. The prevalence of OSA was higher in patients with acute renal failure. Moreover, they concluded that sleep apnea and acute renal failure were associated with CABG (19). However, in the present study, renal dysfunction was similar in both groups (3.4%; P=0.639). Diken et al. investigated the use of the STOP-BANG questionnaire to predict OSA related to post-operative pulmonary changes during CABG surgery in 61 candidates who were consulted for pre-operative pulmonary. Their results indicated that 36.1% of the patients had a high risk for OSA and concluded that the STOP-BANG questionnaire could predict the risk of OSA and pulmonary complications related to OSA in patients scheduled for CABG for whom pre-operative polysomnography could not be performed due to technical or time limitations (20). However, in the present study, there was no significant difference between the two groups in the incidence of cardiovascular and pulmonary complications.

Amra et al. used the Berlin questionnaire to evaluate patients who were candidates for elective CABG. After surgery, the patients were evaluated for post-operative complications, ICU re-admission, intubation length, and length of stay in the ICU and the ward. Among 61 patients evaluated in their study, 40.9% of the cases had OSA. They concluded that OSA is more prevalent but less diagnosed in patients undergoing CABG. Obstructive sleep apnea was associated with a longer intubation time (21) in these patients, which was also observed in the present study. Small sample size and non-use of polysomnography for OSA diagnosis were among the limitations of this study.

Conclusion

In conclusion, snoring decreases oxygen saturation, extubation time, and length of hospital stay in patients who are candidates for CABG. Therefore, patients should be classified in terms of snoring severity to determine the risk of post-operative CABG complications and the prognosis after the operation. Therefore, in light of the necessary measures required for these groups,

snoring could be evaluated and treated even before the onset of cardiac, pulmonary, and brain complications. By all means, further research is warranted due to the small sample size of this study.

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Conflict of Interest

The authors declare no conflict of interest.

References

1. Sabzmakani L, Hazavoiy M, Rabiy M. Predisposing, Reinforcing, Enabling Causes in Educational Diagnosis and Evaluation (PRECEDE). Payesh. Journal of The Iranian Institute For Health Sciences Research 20098 (1): 76 Persian. 2009.
2. Naghibi S, Kordi MR, Maleki MJ, Yarmohammadi M. Effect of concurrent training on hemodynamic responses in male patients with coronary artery disease. Archives of Rehabilitation. 2007;8(3):6-11.
3. Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, Young WL. Miller's Anesthesia E-Book. philadelphia: Elsevier Health Sciences; 2015.
4. Sleep-related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research. The Report of an American Academy of Sleep Medicine Task Force. Sleep. 1999;22(5):667-89.
5. Punjabi NM. The epidemiology of adult obstructive sleep apnea. Proceedings of the American Thoracic Society. 2008;5(2):136-43.
6. Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, et al. Sleep apnea and cardiovascular disease: An american heart association/american college of cardiology foundation scientific statement from the american heart association council for high blood pressure research professional education committee, council on clinical cardiology, stroke council, and council on cardiovascular nursing in collaboration with the national heart, lung, and blood institute national center on sleep disorders research (national institutes of health). Journal of the American College of Cardiology. 2008;52(8):686-717.
7. Kaw R, Michota F, Jaffer A, Ghamande S, Auckley D, Golish J. Unrecognized sleep apnea in the surgical patient: implications for the perioperative setting. Chest. 2006;129(1):198-205.
8. Sériès F, Roy N, Marc I. Effects of sleep deprivation and sleep fragmentation on upper airway collapsibility in normal subjects. American journal of respiratory and critical care medicine. 1994;150(2):481-5.
9. Eastwood PR, Platt PR, Shepherd K, Maddison K, Hillman DR. Collapsibility of the upper airway at different concentrations of propofol anesthesia. Anesthesiology: The Journal of the American Society of Anesthesiologists. 2005;103(3):470-7.
10. Kaw R, Golish J, Ghamande S, Burgess R. Incremental risk of obstructive sleep apnea on cardiac surgical outcomes. Journal of Cardiovascular Surgery. 2006;47(6):683.
11. Eastwood PR, Szollosi I, Platt PR, Hillman DR. Collapsibility of the upper airway during anesthesia with isoflurane. Anesthesiology: The Journal of the American Society of Anesthesiologists. 2002;97(4):786-93.
12. de Jesus Danzi-Soares N, Genta PR, Nerbass FB, Pedrosa RP, Soares FSN, César LAM, et al. Obstructive sleep apnea is common among patients referred for coronary artery bypass grafting and can be diagnosed by portable monitoring. Coronary artery disease. 2012;23(1):31-8.
13. Diken ÖE, Diken Aİ, Yalçınkaya A, Gülbay B, Acıcan T, Demir E, et al. Predictive Value of STOP-BANG on OSAS-Related Complications Following Coronary Artery Bypass Grafting. Respiratory care. 2018;63(10):1264-70.
14. Aliasgharpoor M, Eybpoosh S. QUALITY OF SLEEP AND ITS CORRELATING FACTORS IN RESIDENTS OF KAHRIZAK NURSING HOME. Journal of Nursing and Midwifery Urmia University of Medical Sciences. 2011;9(5):0-.
15. d r Johns' personal website about the ESS. Available at:http://epworthsleepinessscale.com/about-the-ess/. Accessed November 21, 2011.
16. Hwang D, Shakir N, Limann B, Sison C, Kalra S, Shulman L, et al. Association of sleep-disordered breathing with postoperative complications. Chest. 2008;133(5):1128-34.
17. Vgontzas AN, Papanicolaou DA, Bixler EO, Hopper K, Lotsikas A, Lin H-M, et al. Sleep apnea and daytime sleepiness and fatigue: relation to visceral obesity, insulin resistance, and hypercytokinemia. The Journal of Clinical Endocrinology& Metabolism. 2000;85(3):1151-8.
18. lexopoulos EI, Theologi V, Malakasioti G, Maragozidis P, Tsilioni I, Chrousos G, et al. Obstructive sleep apnea, excessive daytime sleepiness, and morning plasma TNF-α levels in Greek children. Sleep. 2013;36(11):1633-8.
19. Kua J, Zhao L-P, Kofidis T, Chan S-P, Yeo T-C, Tan H-C, et al. Sleep apnoea is a risk factor for acute kidney injury after coronary artery bypass grafting. European Journal of Cardio-Thoracic Surgery. 2015;49(4):1188-94.
20. Diken ÖE, Diken Aİ, Yalçınkaya A, Gülbay B, Acıcan T, Demir E, et al. Predictive Value of STOP-BANG on OSAS-Related Complications Following Coronary Artery Bypass Grafting. Respiratory care. 2018;63(10):1264-70.
21. Amra B, Niknam N, Sadeghi MMM, Rabbani M, Fietze I, Penzel T. Obstructive sleep apnea and postoperative complications in patients undergoing coronary artery bypass graft surgery: a need for preventive strategies. International journal of preventive medicine.2014;5(11)