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Research Article

The Coexistence of Obstructive Sleep Apnea in Patients with Slow Coronary Flow: Questionnaire Study

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Abstract

Objectives: Both Obstructive sleep apnea (OSA) and coronary slow-flow (CSF) have similar pathogenic mechanisms, such as chronic sympathetic activation, upregulation of inflammatory pathways. However, importance true coincidence and of CSF and OSA is not known very well. In this study, we examined the presence of OSA by using questionnaire, including Berlin questionnaire (BQ), STOP-Bang questionnaire, and Epworth (ESS) in the patients diagnosed CSF after coronary angiography.

Methods: This prospective study included 4515 patients admitted angiography laboratory. Of the patients, 336 patients were diagnosed CSF in coronary angiography. Control group patients (n=40) had normal coronary artery, which was no slow coronary flow, no OSA. The patients with CSF were asked with sleep questionnaire.

Results: Of 4515 patients, 336 (7.4%) met the criteria for CSF. After sleep questionnaire, BQ scores were 276/336 in patients (82.1%). ESS scores of 11-24 were 134/336 in patients (39.8%). Of 336 patients, 254 patients were ≥ 3 scores for STOP -Bang questionnaire (75.59%).

Conclusion: We demonstrated association with coronary CSF and OSA via the usage of questionnaire. However, more large studies require to evaluate the relationship between OSA and CSF.

Keywords: Coronary slow flow, obstructive sleep apnea, sleep questionnaire

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Obstructive sleep apnea (OSA) is associated with decreased airflow to upper airway obstruction, which is associated with progressive respiratory effort to overcome the obstruction.[1] If untreated, it is increased cardiovascular morbidity and mortality reason.[2] Unfortunately, population-based studies estimate that 90% of cases OSA in the communities of advanced economies remain undiagnosed and untreated.[3] On the other hand, coronary slow-flow phenomenon (CSF) was defined as delayed distal opacification of the coronary artery without occlusion.[4, 5] The CSF can be in appearance from mild chest discomfort to ST-segment elevation myocardial infarction.

Both OSA and CSF have similar pathophysiology, such as chronic sympathetic activation, upregulation of inflammatory pathways, oxidative stress, and endothelial dysfunction.[6, 7] However, importance true coincidence and of CSF and OSA is not known very well. In this study, we examined the presence of OSA by using questionnaire, including Berlin questionnaire, STOP-Bang questionnaire, and Epworth in the patients diagnosed CSF after coronary angiography.

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Methods

This prospective cross-sectional study included 4515 patients admitted angiography laboratory because of possible coronary artery disease in between February 2018 to March 2019. The indication for coronary angiography was the presence of angina or dyspnea with a high-risk noninvasive test. All patients were informed and a written informed consent was obtained from each patient. The study was approved by the ethics committee [Number, 2018/1]. The study was conducted in accordance with the principles of Declaration of Helsinki.

Of the patients, 336 patients were diagnosed CSF in coronary angiography. The diagnosis of the CSF can be made on the basis of the TIMI flow grade or TIMI frame count (TFC) on coronary angiography.[8]

The demographic data, clinical histories, atherosclerosis risk factors, and laboratory and angiographic findings of all CSF were collected.

The exclusion criteria were valvular heart disease (more than mild), ventricular dysfunction pulmonary arterial hypertension (pulmonary artery systolic pressure above 25 mm Hg in transthoracic echocardiography),coronary slow flow secondary to coronary ectasia or spasm, connective tissue disorders, presence of congenital heart anomalies, heart rhythm disorders other than sinus tachycardia, and acute coronary syndrome.

Control group patients (n=40) had normal coronary artery, which was no slow coronary flow, no OSA. The patients with CSF were questioned with sleep questionnaire.

Coronary Angiography, CTFC Slow Coronary Flow

Standard left and right coronary angiography was performed in all case and control patients via the femoral approach, using Judkins catheters. The angiograms were assessed, and coronary flow quantification was performed using the corrected TFC method (CTFC) described by Gibson et al.[8] The assessment was performed by an expert interventional cardiologist who was blinded to the clinical details of the study population. The first frame was defined as the first frame in which dye completely filled the entrance of the artery with antegrade flow, and the last frame was defined as the frame in which dye entered the distal landmark branch. The diagnosis of SCF was defined as CTFC >27 frames (images acquired @ 30 frames/s) and the delayed distal vessel opacification is in at least one epicardial vessel.

Berlin Questionnaire

The Berlin questionnaire (BQ) includes questions about snoring, daytime somnolence, body mass index (BMI), and hypertension, is a brief and validated screening tool that identifies persons in the community who are at high risk for OSA. According to BQ, the patients were recorded as being at high-risk for OSA if they had a positive score on two or more categories.[9]

STOP–Bang Questionnaire

The STOP-BANG questionnaire has four yes/no questions and four clinical features.[10] Scores ≥3 predict a higher likelihood of OSA.

Epworth Sleepiness Scale:

The Epworth Sleepiness Scale (ESS) is a questionnaire involving eight questions to assess the propensity for daytime sleepiness or dozing.[11] ESS scores of 11-24 can described increasing levels of excessive daytime sleepiness.

Statistical Analysis

The quantitative distribution of returned questionnaires, individual patient variables were expressed by descriptive statistics (frequencies, means and standard deviations, and range). The comparison of CTFC features, body mass indexes, and age of study group with control group were evaluated using the chi-square test. A p value <0.05 was used to determine statistical significance.

Results

Of 4515 patients, 336 (7.4 %) met the criteria for CSF. After BQ, 276 patients had high-score BQ (82.1%). This 276 patients were evaluated. Of 276 patients had 188 male (68%). The mean ages were 48.48±7.61 years. Body mass index (BMI, (kg/m^2) according to WHO criteria [14] was 33.02±2.18 kg/m^2. CTFC in CSF group were LAD 33.85±3.66, LCX 33.71±4.56, and RCA 34.31±4.04. CTFC values were compared with control group (no slow coronary flow patients, n=40). In control group, CTFC values were LAD 23.83±1.80, LCX 20.83±2.51, RCA 21.75±2.86 ($p<0.05$). Demographic data in 276 CSF subjects were presented in Table 1.

In table 2. The relationship between angiographic CTFC features, body mass index, and age of study group (SCF (+), OSA (+)) with control group (SCF (-), OSA (-) were compared.

Berlin questionnaire scores

The BQ includes questions about snoring (category 1), daytime somnolence (category 2), and hypertension or BMI >30 kg/m^2 (category 3). Patients were scored as being at high-risk for OSA if they had a positive score on two or more categories. Of 276 high-risk patients, 155 (56.1%) had a positive score in category 1 of the BQ, 165 (59.7%) had a positive score in category 2, and 195 (70.6 %) had a positive score in category 3.

Table 1. Baseline characteristics of 276 patients with slow coronary flow (CSF)

	X±SD	%
Age (years)	48.42±7.65	
Men (gender)	188	68
Women (gender)	88	32
Hypertension	118	42.7
Diabetes Mellitus	27	7.5
BMI (kg/m^2)	33.02±2.18	

Table 2. The comparison of Angiographic Corrected TIMI frame count features, Body Mass Indexes, and age of study group (SCF (+), OSA (+)) with control group (SCF (-), OSA (-))

	Study group (n=276)	Control group (n=40)	p
LAD ctfc	33.85±3.66	23.83±1.80	<0.001
LCX ctfc	33.71±4.56	20.83±2.51	<0.001
RCA ctfc	34.31±4.04	21.75±2.86	<0.001
BMI	33.02±2.18	27.12±2.16	<0.001
Age	48.42±7.65	48.05±7.07	>0.05
BQ scores	276/336	5/40	<0.001
ESS	134/336	1/40	<0.001
STOP-Bang	254/336	6/40	<0.001

SCF: Slow Coronary Flow; OSA: Obstructive Sleep Apnea; LAD: Left Anterior Descending Artery; LCX: Left Circumflex Artery; RCA: Right Coronary Artery; CTFC: Corrected TIMI Frame Count; TIMI: Thrombolysis in Myocardial Infarction; BMI: Body Mass Index; BQ score: Berlin questionnaire scores; ESS: Epworth Sleepiness Scale; STOP- Bang: STOP-Bang score.

STOP -Bang questionnaire

Of 336 patients, 254 patients were 3 scores according to STOP-Bang questionnaire (Table 3).

Epworth Sleepiness Scale

Of 336 patients, ESS scores of 11-24 were 39.8% (134/336) according to ESS questionnaire (Table 4).

Discussion

The clinical symptoms in OSA include loud snoring, witnessed breathing pauses, choking or gasping during sleep, and daytime sleepiness.[12] Oxygen desaturation in sleep cause sleep fragmentation and increased sympathetic neural activity.[13] CSF is connected with causes such as inflammation, small vessel disease, and endothelial dysfunction.[14, 15] Endothelin-1 (ET-1) levels were found high in patients with SCF.[16] In addition, the level of C-reactive protein is significantly higher in CSF patients.[17] Both OSA and CSF is associated with chronic sympathetic activation, upregulation of inflammatory pathways, oxidative stress, and endothelial dysfunction have seen. Moreover, hypoxemia stimulates chemoreflex stimulation, which cause sympathetic activation and vasoconstriction in OSA.[18] There are very high levels of sympathetic activation in the patients with OSA.[19]

Polysomnography (PSG) is the gold standard test for diagnosing OSA, but given the expense, time-consumption.[20] As screen test, BQ has a high sensitivity for OSA (proportion of patients with OSA who screen positive).[21] The high-risk group have a sensitivity of 0.86, a specificity of 0.77, a positive predictive value of 0.89 for predicted OSA.[9] Therefore, BQ is a bedside and validated screening tool that identifies persons in the community who are at high risk for OSA. Another test, The STOP-Bang questionnaire easy to use. It has eight questions with a yes or no answer.[10] The STOP-Bang score of ≥3 confirmed a very high sensitivity for moderate/severe OSA. The STOP-BANG questionnaire has high sensitivity (93%), but low specificity (36%) for the detection of OSA.[20] Third questionnaire; ESS has showed as sensitivity of 36% and specificity of 77% for OSA.[20, 22] A score of 11 or higher represents excessive daytime sleepiness.

Yumino et al.[23] showed that the prevalence of OSA was 57% in acute coronary syndromes. Lee et al.[24] reported that 65.7% of patients presenting with ST-segment elevation myocardial infarction had undiagnosed OSA. More-

Table 3. The STOP-Bang Score for Obstructive Sleep Apnea

Snore loudly?	No (0 point)	Yes (+1 point)
Often feel, fatigued, or sleepy during the daytime?	No (0 point)	Yes (+1 point)
Observed stop-breathing period during sleep?	No (0 point)	Yes (+1 point)
Hypertension presence	No (0 point)	Yes (+1 point)
Body mass index	35 kg/m^2 (0 point)	>35 kg/m^2 (+1 point)
Age	≤50 years (0 point)	>50 years (+1 point)
Neck circumference	≤40 cm (0 point)	>40 cm (+1 point)
Gender	Female (0 point)	Male (+1 point)

Scores ≥3 predict a higher likelihood of moderate/severe OSA.

Table 4. Epworth Sleepiness Scale

Questions	Score calculation
Sitting and reading	0= would never doze
Watching TV	1= slight chance of dozing
Sitting inactive in a public place, such as a meeting or theatre	2= moderate chance of dozing
Riding as a passenger in a car for an hour without a break	3= high chance of dozing
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
Sitting in a car, stopped for a few minutes in traffic	

Score interpretation: 0 to 10=normal range; 11 to 14=mild sleepiness; 15 to 17=moderate sleepiness; 18 to 24=severe sleepiness.

over, the present study had no patients with acute coronary syndromes. According to our results, 276 out of 336 (82.1 %) CSF patients were high risk of OSA due to BQ. Moreover, it has been known that there are ethnic differences in the prevalence and severity of OSA.[25]

BMI and gender are important factor to interpreting the OSA study. It has been confirmed increase in the prevalence of OSA with any increase in measures of BMI.[25] Hence, there may need to adjust the BMI factor to exclude the possible confounder in OSA studies. However, in our study, BMI was 33.02±2.18 kg/m^2. Besides, the prevalence of OSA is only 1.5–3 times higher in men than women.[26] The present study patients had 188 male (68%).These results were well-matched with other studies.

Present study established that OSA could associated with CSF pattern. Therefore, the patients with CSF should be questioned about OSA.

To know association of OSA and CSF may be contribute to understand pathophysiology of CSF. OSA may perhaps trigger the pathways leading to CSF or CSF can contribute to OSA morbidity-mortality). Hence, the presence of OSA might take into consideration in the therapeutic approach to CSF.

Limitation: These patients not underwent PSG.

Conclusion

We demonstrated relationship between CSF and OSA by using questionnaire. However, more large prospective controlled studies using PSG and CSF are required to further evaluate the relationship between OSA and CSF.

Disclosures

Ethics Committee Approval: The Ethics Committee of Medicana International Ankara Hospital provided the ethics committee approval for this study (2018/01).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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