Relation Between Obstructive Sleep Apnea and Duration of QRS Complex

Fatih Aygün[1], Harun Karamanlı[2]

[1] Department of Cardiovascular Surgery, Başkent University, Konya Medical and Research Center, Konya, Turkey
[2] Department of Pulmonology, Faculty of Medicine Mevlana University, Konya, Turkey

ABSTRAC T

Introduction: To investigate the relation between severity of obstructive sleep apnea (OSA) and widened QRS complex on electrocardiogram.

Patients and Methods: The present study comprised 85 subjects diagnosed with OSA at our clinic between March 2013 and September 2014. PSG reports were reviewed by a self-proclaimed expert physician. Whilst the patients with severe sleep apnea disease were assigned to Group 1, patients with mild-moderate sleep apnea disease were assigned to Group 2.

Results: The age of the patients participated in the study ranged between 20 years (y) (minimum-min) and 85 years (maximum-max) (mean ± standard deviation 48.5 ± 13.2 y). Of these subjects, 51 (60%) were male and 34 (40%) were female. Mean duration of QRS complex was 0.112 ± 0.016 seconds (sec) in Group I consisted of patients with severe OSA of which Polysomnography (PSG) records and scoring were done using ALICE 6 system, whereas it was 0.080 ± 0.017 sec in Group 2.

Conclusion: It was observed that duration of QRS complex was longer in the patients with severe OSA as compared to those with mild-moderate OSA. The result was statistically significant (p< 0.01).

Key Words: Monitoring sleep; electrocardiogram; obstructive sleep apnea

Obstrüktif Uyku Apne Şiddeti ile QRS Süresi Arasındaki İlişkinin Araştırılması

ÖZET

Giriş: Bu çalışmada, obstrüktif uyku apnesi (OSA) şiddeti ile elektrokardiyogramdaki QRS süresinin genişlemesi arasındaki ilişki araştırılmıştır.

Hastalar ve Yöntem: Bu çalışma; kliniğimizde Mart 2013 ve Eylül 2014 tarihleri arasında, OSA tanısı almış 85 kişiyi içermektedir. PSG raporları alanında uzman hekim tarafından değerlendirildi. Şiddetli uyku apne hastalığı olan bireyler Grup 1 olarak adlandırılırken, orta, hafif uyku apne hastalığı olan bireyler Grup 2 olarak belirlendi.

Bulgular: Çalışmaya katılan tüm bireylerin yaş dağılımı; minimum(min) 20 yıl (y), maksimum(max) 85 yıldır (ortalama ± standart sapma 48.5 ± 13.2 y). Bu kişilerin 51 (%60)'i erkek, 34 (%40)' ü kadındır. Polisomnografi (PSG) kayıtları ve skorlaması ALICE 6 system kullanılarak oluşturulan, şiddetli OSA'sı olan bireyleri içeren Grup 1'de QRS süresi 0.112 ± 0.016 saniye iken Grup 2' de 0,080 ± 0,017 saniye olduğu görüldü.

Sonuç: Şiddetli OSA'sı olan bireylerin, hafif ve orta şiddette OSA'sı olan bireylere göre QRS sürelerinin yüksek olduğu görüldü. Sonucun istatiksel olarak anlamlı olduğu tespit edildi (p< 0.01).

Anahtar Kelimeler: Uyku monitorizasyonu; elektrokardiyogram; obstrüktif uyku apnesi

INTRODUCTION

Obstructive sleep apnea (OSA) is frequently encountered among obese people. It is defined as recurrent closure of the upper airway while respiratory effort is ongoing during sleep. Apnea leads to decrease in negative intrathoracic pressure and in arterial oxygen saturation. Cardiac arrhythmias and conduction alterations are common in the people with OSA[1-9].

OSA is a breathing disorder during sleep with a prevalence rate of 10-15% in males and 4-7% in females[10]. OSA involves many systems, particularly cardiovascular system. Although the association of OSA with cardiovascular events such as hypertension, congestive heart failure and sudden death is known, etiopathological mechanism of the association with many of these remains unclear[11-15].

Yazışma Adresi

Fatih Aygün

E-posta: fatihaygun@ttmail.com
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Many studies have demonstrated association between OSA and widened QRS complex on electrocardiogram (ECG)[16-20]. There are studies suggesting that duration of QRS complex is an independent predictor of sudden death in case that OSA is accompanied by hypertension or heart failure[21-23].

The present study investigated the relation between severity of OSA and widened QRS complex.

PATIENTS and METHODS

Clinical Characteristics of Patients

The study comprises 85 subjects diagnosed with OSA at our clinic between March 2013 and September 2014. Data were retrospectively collected and approval of the ethical committee was obtained.

All the subjects were investigated in terms of age, gender, smoking status, hypertension, diabetes mellitus, hyperlipidemia, family history of coronary artery disease, congestive heart failure and atrial fibrillation.

Height (human bascule, NAN TARTI Co, Turkey) and weight (TANITA Body Composition Analyzer, TANITA Corporation, Japan) of the participants were measured, and their body mass indexes (BMI) were calculated. A BMI lower than 25 kilograms (kg)/square meter (m^2) (BMI< 25 kg/m^2) was considered normal weight, between 25 kg/m^2 and 30 kg/m^2 (25 $kg/m^2 \leq$ BMI < 30 kg/m^2) was considered overweight, and 30 kg/m^2 and over (30 $kg/m^2 \leq$ BMI) was considered obese.

Electrocardiographic Evaluation

Resting ECG was obtained from electronic recordings. Heart rate and duration of QRS complex were obtained from computed ECG monitoring (ALICE 6 Analysis program, PHILIPS). Duration of QRS complex during sleep was measured in seconds (sec).

Polysomnographic Evaluation

At baseline, all subjects were evaluated by a self-proclaimed expert physician in terms of sleep apnea disease. Patients that were considered available for polysomnography (PSG) were referred to the sleep laboratory. Four-channel EEG (C3-A2, C4-A1, O1-A2, O1-A1), two-channel electrooculography, electromyogram of the mandible and the left and right tibialis anterior, body position, oro-nasal air flow, thoracic and abdominal respiratory movements, ECG, respiratory sounds, oxygen saturation, continous positive airway pressure (CPAP) and synchronous video were recorded as the parameters. Above-mentioned parameters, as well as PSG, were measured in each subject during night sleep. Records were evaluated according to the 2007 International Classification of Sleep Disorders. PSG recording and scoring were done using ALICE 6 system. OSA was considered moderate-mild if apnea-hypopnea index was between 5 and 30 and severe if apnea-hypopnea index was higher than 30.

Groups

The study comprised a total of 85 subjects. PSG reports were evaluated by a self-proclaimed expert physician. Whilst the subjects with severe sleep apnea disease were assigned to Group 1, the subjects with moderate-mild sleep apnea disease were assigned to Group 2.

Statistical Analysis

Statistical analysis were done using SPSS program (SPSS Inc., Chicago, IL, USA). Statistical significance of nonparametric data between the groups was analyzed by Chi-Square Test and Ficher's Exact Test (because observed values were below the expected values). Whilst the parametric data were represented as minimum, maximum and mean ± standard deviation, statistical significance of parametric data between the groups was analyzed by independent student t-test. The result was considered statistically significant if two-tailed p value was smaller than 0.05 ($p< 0.05$) (Table 1).

RESULTS

Subject Characteristics

Age distribution of all study participants ranged between 20 years (y) (minimum-min) and 85 years (maximum-max) (mean ± standard deviation 48.5 ± 13.2 y). Of these subjects, 51 (60%) were male and 34 (40%) were female. The number of smokers was 37 (43.5%) and there were 7 (8.2%) subjects with diabetes mellitus type 2, 15 (17.6%) subjects with dyslipidemia and 27 (31.8%) subjects with hypertension (HT). With regard to BMI, there were 11 (12.9%) normal weight subjects, 40 (47.1%) overweight subjects and 34 (40%) obese subjects. Eleven (12.9%) patients had coronary artery disease, no (0%) patient had congestive heart failure and no 0 (0%) patient had atrial fibrillation. Duration of QRS complex was between 0.053 sec (min) and max 0.132 sec (mean ± standard deviation 0.093 ± 0.023 sec).

Group Characteristics

In the males of Group I, mean duration of QRS complex was 0.111 ± 0.016 sec and mean age was 47.7 ± 14.2 y. There were 15 smokers (57.7%), 9 obese subjects (34.6%), 3 (11.5%) patients with diabetes mellitus, 4 (15.4%) patients with dyslipidemia, 5 (19.2%) patients with hypertension, 4 (15.4%) patients with coronary artery disease, no (0%) patient with congestive heart failure, and no (0%) patient with atrial fibrillation.

In the females of Group I, mean duration of QRS complex was 0.114 ± 0.016 sec and mean age was 57 ± 7.7 y. There was 3 (30%) smoker, 7 (70%) obese subjects, 1 (10%) subject with diabetes mellitus, 3 (30%) subjects with dyslipidemia, 4 (40%) subjects with hypertension, 1 (10%) subject with coronary artery disease, no (0%) subject with congestive heart failure, and no (0%) subject with atrial fibrillation.

In the males of Group 2, mean duration of QRS complex was 0.079 ± 0.018 sec and mean age was 45.6 ± 13.7 y. There were

Table 1. Demographical characteristics of patients

	Group 1 (n= 36)	Group 2 (n= 49)	p value
Age (± SD)	50.3 ± 13.3	47.2 ± 13.1	0.291[T]
Gender (male)	26 (72.2%)	25 (51%)	0.049[C]
Smoking	18 (50%)	19 (72.2%)	0.302[C]
Body weigt			
Normal	0 (0%)	11 (22.4%)	
Over weight	20 (55.6%)	20 (40.8%)	*0.473[C]
Obesity	*16 (44.4%)	*18 (36.7%)	
BMI	30.3 ± 3.6	29.2 ± 5.4	0.299
Diabetes mellitus type 2	4 (11.1%)	3 (6.1%)	0.450[F]
Dyslipidemia	7 (19.4%)	8 (16.3%)	0.709[C]
Hypertension	9 (25%)	18 (36.7%)	0.251[C]
Coronary artery disease	5 (13.9%)	6 (12.2%)	0.823[C]
Congestive heart failure	0 (0%)	0 (0%)	-
Atrial fibrillation	0 (0%)	0 (0%)	-
QRS complex (sec)	0.112 ± 0.016	0.080 ± 0.017	<0.001[T]

* P value was calculated according to obesity
[T] : P value was presented as a result of Student t-test
[C] : P value was presented as a result of Chi-Square Test
[F] : P value was presented as a result of Fisher's Exact Test
BMI: Body Mass Index, SD: Standart deviation, Sec: Second

13 (52%) smokers, 8 (32%) obese subjects, 2 (8%) patients with diabetes mellitus, 4 (16%) patients with dyslipidemia, 8 (32%) patients with hypertension, 4 (16%) patient with coronary artery disease, no (0%) patient with congestive heart failure, and no (0%) patient with atrial fibrillation.

In the females of Group 2, mean duration of QRS complex was 0.080 ± 0.016 sec and mean age was 48.8 ± 12.5 y. There were 6 (25%) smokers, 10 (41.7%) obese subjects, 1 (4.2%) patient with diabetes mellitus, 4 (16.7%) patients with dyslipidemia, 10 (41.7) patients with hypertension, 2 (8.3%) patients with coronary artery disease, no (0%) patient with congestive heart failure, and no (0%) patient with atrial fibrillation.

Areas, in which duration of QRS complex on ECG were accumulated according to age and BMI, are illustrated in Figure 1 and 2.

DISCUSSION

In the present study, duration of QRS complex was found longer in Group 1 consisted of patients with severe OAS as compared to Group 2 consisted of patients with moderate-mild OAS. The difference between Group 1 and Group 2 was found statistically significant ($p < 0.05$). Statistical data between the groups are demonstrated in Table 1.

Obstructive sleep apnea (OSA) is called as recurrent closure of upper airway while respiratory effort is ongoing during sleep. Apnea is accompanied by decrease in negative intrathoracic pressure and arterial oxygen saturation. Cardiac arrhythmias and alterations in cardiac conduction are frequently encountered in the subjects with OSA[1-9].

OSA accompanied by widened QRS complex is seen in the presence of certain cardiologic conditions including hypertension, congestive heart failure, ventricular arrhythmia, and enhanced left ventricle mass[1,12,13]. In OSA, breathing occurs against closed upper airway. It is characterized by increased negative intrathoracic pressure, which results in increased left ventricle transmural pressure and afterload[24].

Drager et al. stated that OSA alters cardiac structure and enhances left ventricle mass[16]. Many studies appear to support this statement[17-19]. Enhanced left ventricle mass leads to electrocardiographic alterations. Normal duration of QRS complex is between 0.04 and 0.08 sec. Ott et al. expressed that a QRS complex of 120 milliseconds (msec) and longer is an independent risk factor for sudden death[22].

Many studies have demonstrated that OSA is associated with left ventricle hypertrophy, which is characterized by widened QRS complex on ECG[16-20]. There are studies revealing that duration of QRS complex is an independent predictor of sudden death in case OSA is accompanied by hypertension or heart failure[21-23].

It has been found that a QRS complex longer than 120 msec is independent predictor of mortality and sudden death[21,22]. In the present study, although mean duration of QRS complex was shorter than 120 msec (0.111 ± .016 sec) in Group 1 consisted of patients with severe OSA, it was higher than mean

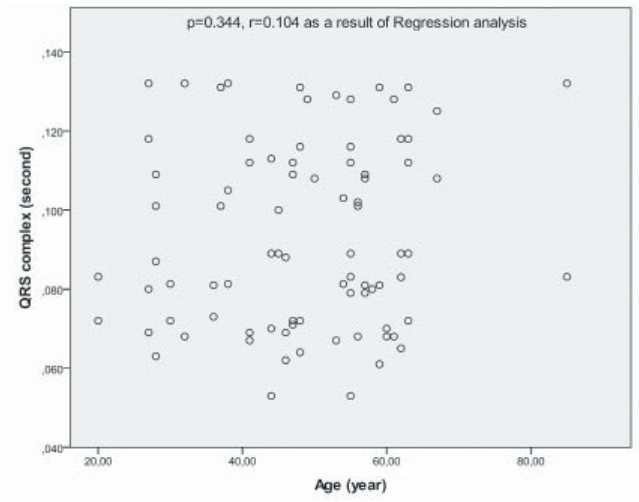

Figure 1. QRS complex duration according to age.

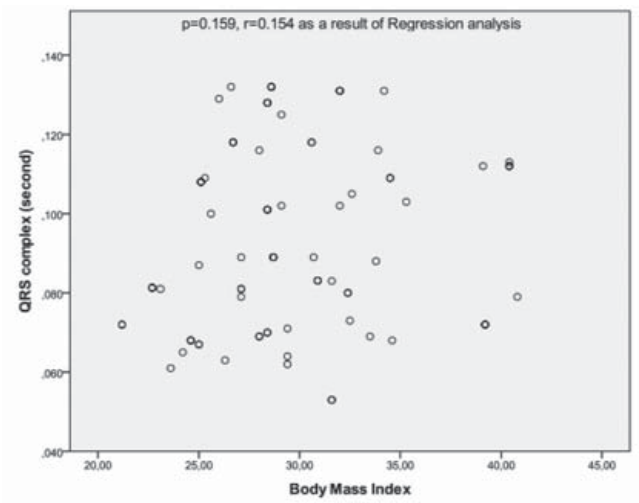

Figure 2. QRS complex duration according to BMI.

duration of QRS complex in Group 2 consisted of patients with moderate and mild OSA.

In conclusion, based on the results of the present study, it can be said that duration of QRS complex is longer in the subjects with severe OSA as compared to those with mild-moderate OSA. We think that subjects with severe OSA should be informed about cardiovascular problems due to widened QRS complex. We believe that our results need to be supported by larger-scale studies.

Study Limitations

Study participants are the Caucasians living in the same geographical region. Number of the subjects in the groups is adequate for statistical analysis but inadequate to adapt the results to the population. They have been followed for short time. Therefore, larger epidemiological studies are needed to verify the results of the present study.

CONFLICT of INTEREST

The authors reported no conflict of interest related to this article.

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*Selçuk University, Zootechnics Division, Department of Biometry and Genetics, Konya, TURKEY.

AUTORSHIP CONTRIBUTIONS

Concept/Design: FA
Analysis/Interpretation: FA
Data acquisition: HK
Writing: FA
Critical revision: FA, HK
Final approval: FA, HK

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