

Evaluation of Ventricular Repolarisation Features with Novel Electrocardiographic Parameters in Patients with Severe Periodontitis

Şiddetli Periodontitisli Hastalarda Ventriküler Repolarizasyon Özelliklerinin Yeni Elektrokardiyografik Parametrelerle Değerlendirilmesi

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ABSTRACT

Introduction: Ventricular arrhythmic predictors in severe periodontitis may be linked with cardiovascular events and the sudden death risk. In this study, we evaluated certain electrocardiographic (ECG) ventricular arrhythmic predictors in patients with severe periodontitis.

Methods: ECG parameters of 72 patients diagnosed with severe periodontitis, which are indicative of ventricular arrhythmia, were examined, and these parameters were compared with the control group.

Results: Compared to the control group, QT interval (QT) ($p=0.014$), corrected QT (QTc) ($p<0.001$), QT dispersion (QTd) ($p<0.001$), QTdc ($p<0.001$), JT interval ($p=0.012$), JTc interval ($p<0.001$), T peak and end interval (Tp-e) ($p<0.001$), Tp-e/QT ratio ($p<0.001$), Tp-e/QTc ratio ($p<0.001$), Tp-e/JT ratio ($p<0.001$) and Tp-e/JTc ratio ($p<0.001$) were found to be higher in patients with severe periodontitis.

Conclusion: Our study showed that arrhythmic ECG markers were significantly prolonged in patients with severe periodontitis. In future extensive prospective studies, we think that these arrhythmic predictors should be evaluated to predict malignant arrhythmias.

Keywords: Arrhythmia, electrocardiography, periodontitis, JT interval, Tp-e/QTc ratio

ÖZ

Amaç: Şiddetli periodontitiste ventriküler aritmik prediktörler kardiyovasküler olaylar ve ani ölüm riski ile ilişkili olabilir. Bu çalışmada şiddetli periodontitisli hastalarda bazı elektrokardiyografik (EKG) ventriküler aritmik prediktörler değerlendirilmiştir.

Yöntemler: Şiddetli periodontitis tanısı alan 72 hastanın, ventriküler aritminin göstergesi olan EKG parametreleri incelendi ve bu parametreler kontrol grubuyla karşılaştırıldı.

Bulgular: Kontrol grubu ile karşılaştırıldığında, şiddetli periodontitisli hastalarda QT aralığı ($p=0.014$), düzeltilmiş QT aralığı (QTc) ($p<0.001$), QT dağılım aralığı (QTd) ($p<0.001$), QTdc aralığı ($p<0.001$), JT aralığı ($p=0.012$), JTc aralığı ($p<0.001$), T tepe ve bitiş aralığı (Tp-e) ($p<0.001$), Tp-e/QT oranı ($p<0.001$), Tp-e/QTc oranı ($p<0.001$), Tp-e/JT oranı ($p<0.001$) ve Tp-e/JTc oranı ($p<0.001$) daha yüksek bulundu.

Sonuç: Araştırmamız, şiddetli periodontitisli hastalarda aritmik EKG belirteçlerin anlamlı şekilde uzadığını göstermiştir. Gelecekteki kapsamlı prospektif çalışmalarda, bu aritmik belirleyicilerin malign aritmileri öngörmek için değerlendirileceğini düşünüyoruz.

Anahtar Kelimeler: Aritmi, elektrokardiyografi, periodontitis, JTc aralığı, Tp-e/QTc oranı

Introduction

Periodontitis is a chronic inflammatory periodontal disease that gradually destroys the supporting structures of the teeth, affecting approximately 50% of the adult population (1). The harmful influences of periodontitis are not only restricted to the oral cavity, but it also affects general health (2). Classification of periodontitis is based on stages defined by the severity, complexity, and distribution (Table 1).

There is consistent and potent epidemiological evidence that periodontitis increases the risk of cardiovascular disease [(CVD); for example, atherosclerosis with different mechanisms] (5).

Electrical changes in the heart throughout ventricular repolarisation can cause fatal rhythm disturbances (6). Myocardial depolarisation and repolarisation have been assessed using various methods. QT interval (QT), QT dispersion (QTd) and corrected QT (QTc) have been linked with ventricular arrhythmic conditions and sudden death (7).



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In recent years, JT, JTC, T peak and end interval (Tp-e) and Tp-e/QT and Tp-e/QTc proportions have also shown to be different parameters indicating fatal ventricular arrhythmias (8).

In this study, we aimed to explore the influence of severe periodontitis on cardiac ventricular arrhythmic abnormalities.

Methods

Study Population

Electrocardiogram (ECG) recordings of 72 patients with periodontitis who were received in the University of Bolu Abant İzzet Baysal Department of Periodontology between July 2018 and December 2018 were cross-sectionally analysed and compared with controls. The study was conducted after obtaining ethical approval from the Bolu Abant İzzet Baysal University Ethics Committee (decision number: 2019/264, date: 21/11/2019).

The study was conducted in compliance with the ethical principles according to the Declaration of Helsinki.

Patients were diagnosed as having periodontitis or were declared to be periodontally healthy based on the criteria proposed by the International Workshop for the Classification of Periodontal Diseases and Conditions in 2017 (1). All patients agreed to participate in the study and gave their written informed consent.

Exclusion Criteria

Participants with a history of diabetes, smoking, hypertension, hyperlipidaemia, structural heart disease, atherosclerotic CVDs (coronary artery disease, etc), ejection fraction <50%, electrolyte imbalances, liver failure, thyroid disorders, renal failure, malignancies, chronic lung disease, or any other systemic illness were excluded. Besides, patients over 45 years old were excluded because of the reduced risk of an arrhythmic event with ageing. Participants with a history of ventricular arrhythmias, atrial fibrillation (AF), and those having left-axis deviation, ST-segment depression, and hypertrophic findings on ECG were also excluded, because of the possible influences of these ECG differences on the computed ECG parameters.

Table 1. The 2017 workshop on the classification of periodontal and peri-implant diseases and conditions (1)

Stages: Based on the severity (3) and complexity of management (4)

Stage I	Initial periodontitis
Stage II	Moderate periodontitis
Stage III	Severe periodontitis with potential for additional tooth loss
Stage IV	Severe periodontitis with potential for loss of the dentition

Table 2. General characteristics of the study groups

Baseline characteristics	Severe periodontitis Mean $\pm$ SD (n=72)	Control group Mean $\pm$ SD (n=72)	p
Age (years)	35.4 $\pm$ 6.7	33.5 $\pm$ 6.4	0.222
Male/female	56/16	46/26	0.200
BMI	25.5 $\pm$ 3.4	25.3 $\pm$ 3.2	0.842

BMI: Body mass index, SD: standard deviation

Electrocardiography

The 12-lead ECG was recorded with the Nihon Kohen Cardiofax ECG-1950 VET device. Two cardiologists, blinded to the data, performed the ECG measurements and calculations manually with the TorQ 150 mm digital caliper LCD device. QT interval was measured, beginning from the initiation of the QRS duration to the end of the T wave. JT interval was measured from the end of the QRS complex to the end of the T wave. QTd was defined as being the difference between the maximum and minimum QT intervals measured at different leads. The Tp-e range is the range from the peak of the T wave to the end of the T wave. QTc, QTdc and JTc were calculated using the Bazett's formula ($QTc = QT/\sqrt{RR}$) (9). Besides, the rates of these intervals calculated, the differences between intra-observer and inter-observer measurements were below 5 percent.

Statistical Analysis

Analyses were conducted using the SPSS 21.0 Statistical Package Program for Windows (SPSS Inc, Chicago, Illinois, USA). Mean $\pm$ standard deviation was used for quantitative variables, and numbers and percentages were used to express qualitative variables. In independent groups, the chi-square test was used for qualitative variables, and the Student t-test was used for quantitative variables. A p value less than 0.05 was considered statistically significant.

Results

The baseline characteristics of the study and control groups were similar (Table 2).

Compared to the control group, QT interval (376.7 $\pm$ 21.4 vs. 362.3 $\pm$ 27.0 ms, $p=0.014$), QTc (404.4 $\pm$ 24.2 vs 381.0 $\pm$ 16.7 ms, $p<0.001$), QTd (26.5 $\pm$ 11.2 vs. 18.0 $\pm$ 5.9 ms, $p<0.001$), QTdc (28.6 $\pm$ 12.0 vs 18.9 $\pm$ 5.7 ms, $p<0.001$), JT interval (293.0 $\pm$ 39.2 vs 272.4 $\pm$ 27.2 ms, $p=0.012$), JTc interval (312.9 $\pm$ 22.6 vs 286.1 $\pm$ 18.3 ms, $p<0.001$), Tp-e interval (106.9 $\pm$ 12.0 vs. 73.6 $\pm$ 7.4 ms, $p<0.001$), Tp-e/QT ratio (0.28 $\pm$ 0.03 vs 0.20 $\pm$ 0.03, $p<0.001$), Tp-e/QTc ratio (0.27 $\pm$ 0.04 vs 0.19 $\pm$ 0.02, $p<0.001$), Tp-e/JT ratio (0.37 $\pm$ 0.05 vs 0.27 $\pm$ 0.03, $p<0.001$) and Tp-e/JTc ratio (0.34 $\pm$ 0.04 vs 0.26 $\pm$ 0.03, $p<0.001$), were found to be higher in patients with severe periodontitis (Table 3), (Figure 1).

Discussion

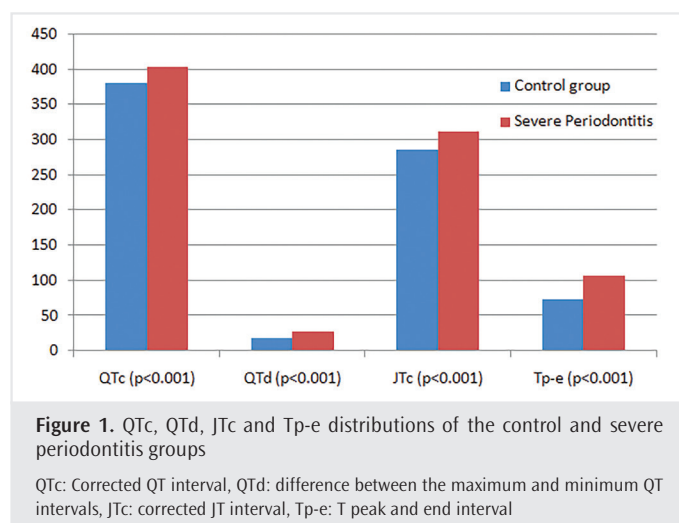
In our study, we showed that periodontitis is significantly linked with arrhythmic predictors. To the best of our knowledge, there is no other study investigating cardiac ventricular markers in periodontitis patients.

Periodontitis is an increasing epidemic health problem that has been thought to be a risk factor for myocardial infarction (10). Although

Table 3. Electrocardiographic findings of the study population

	Severe periodontitis Mean $\pm$ SD (n=72)	Control group Mean $\pm$ SD (n=72)	p
Heart rate (bpm)	70.4 $\pm$ 13.7	67.5 $\pm$ 11.6	0.328
QT ms	376.7 $\pm$ 21.4	362.3 $\pm$ 27.0	0.014
QTc ms	404.4 $\pm$ 24.2	381.0 $\pm$ 16.7	<0.001
QTd ms	26.5 $\pm$ 11.2	18.0 $\pm$ 5.9	<0.001
QTdc ms	28.6 $\pm$ 12.0	18.9 $\pm$ 5.7	<0.001
QRS ms	94.8 $\pm$ 10.2	90.6 $\pm$ 7.6	0.051
JT ms	293.0 $\pm$ 39.2	272.4 $\pm$ 27.2	0.012
JTc ms	312.9 $\pm$ 22.6	286.1 $\pm$ 18.3	<0.001
Tp-e ms	106.9 $\pm$ 12.0	73.6 $\pm$ 7.4	<0.001
Tp-e/QT	0.28 $\pm$ 0.03	0.20 $\pm$ 0.03	<0.001
Tp-e/QTc	0.27 $\pm$ 0.04	0.19 $\pm$ 0.02	<0.001
Tp-e/JT	0.37 $\pm$ 0.05	0.27 $\pm$ 0.03	<0.001
Tp-e/JTc	0.34 $\pm$ 0.04	0.26 $\pm$ 0.03	<0.001

Bpm: Beat per minute, ms: millisecond, QT interval: from the beginning of the QRS complex to the end of the T wave, QTc: corrected QT interval, QTd: QT dispersion: the difference between the maximum and minimum QT intervals, QTdc: corrected QT dispersion, Tp-e: T peak and end interval, JT interval (JT): from the end of the QRS complex (J point) to the end of the T wave, JTc: corrected JT interval, SD: standard deviation



patients with periodontitis are successfully treated, life-long supportive care is recommended for these patients (11). The systematic inflammatory response leads to endothelial dysfunction, and endothelial dysfunction also contributes to CVDs (12), especially electrocardiographic anomalies that are sensitive predictors of lethal coronary heart disease (CHD), and are significantly linked to subsequent death from CHD (13). In the literature, Shimazaki et al. (14) showed a relationship between periodontitis and ECG abnormalities and CVD. Additionally, Im et al. (15) concluded that AF patients with periodontitis, as representative of chronic inflammation, were more prone to have arrhythmic events such as AF, atrial flutter, atrial tachycardia, and any other events than those without periodontitis.

Studies have shown that the QT, QTc, QTd, QTdc, JT, JTc and Tp-e intervals are a risk predictor for arrhythmia and sudden death (7,8,16-18).

The QT is affected by the QRS duration (19). QTd has been declared as an indicator of ventricular arrhythmias (17). Also, an increase in QTd was found to be related to sudden death (18).

The JT interval is the portion of the QT that only shows repolarisation (20). The Tp-e range is a relatively new electrocardiographic parameter showing the entire repolarisation distribution (21,22).

Besides, rates of Tp-e/QTc (23) and Tp-e/JTc (24) have also been found to be related to malignant ventricular arrhythmias.

Periodontitis has been suggested to cause CVDs in different ways. For whatever reason, our study showed that these patients were prone to malignant ventricular arrhythmias. In addition to conventional risk factors for CVDs, inflammation is also considered as being a probable risk factor for CVDs.

Conclusion

Our study showed that arrhythmic ECG markers significantly increased in patients with severe periodontitis.

In future extensive prospective studies, we think that these arrhythmic predictors should be evaluated to predict malignant arrhythmias.

Automatic methods are more recommended than manual measurements (25). Besides, the number of patients in this study may be comparatively small.

Ethics

Ethics Committee Approval: The study was conducted after obtaining ethical approval from the Bolu Abant İzzet Baysal University Ethics Committee (decision number: 2019/264, date: 21/11/2019).

Informed Consent: All patients agreed to participate in the study and gave their written informed consent.

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