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Evaluation of the novel electrocardiographic parameters in patients with acute cholecystitis

Akut kolesistitli hastalarda yeni elektrokardiyografik parametrelerin değerlendirilmesi

Can Ramazan Oncel[1], Hasan Calis[2]*

1.Alanya Alaaddin Keykubat University, School of Medicine, Department of Cardiology, Alanya, Turkey.
2.Alanya Alaaddin Keykubat University, School of Medicine, Department of General Surgery, Alanya, Turkey.

ABSTRACT

Aim: Acute cholecystitis (AC) can display electrocardiographic changes mim-icking cardiovascular disorders. The aim of this study is to evaluate electrocardiographic changes with novel parameters in patients with AC.
Methods: This study included 34 patients with AC and 30 controls. Control group was consisted of age and gender matched individuals without any cardiovascular and systemic disease. Demographic and clinical data were recorded. The electrocardiographic measurements were done in order to calculate QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), Tp-e/QT ratio and p wave durations.
Results: In our study there was no significant difference between two groups in terms of demographic data and clinical features. QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), and p wave durations were similiar in the two groups. No statistically significant difference was found between two groups in terms of p wave dispersion and Tp-e/QT ratio. (38.0±3.9 vs 37.9±4.4, p:0.93; 0.21±0.07 vs 0.20±0.09, p:0.26 respectively)
Conclusion: Patients with acute cholecystitis have similiar electrophysiological properties of myocardium and atrium on electrocardiography as compared with healthy controls.

Key words: Cholecystitis, electrocardiography, electrophysiology

ÖZ

Amaç: Akut kolesistit (AC), kardiyovasküler hastalıkları taklit eden elektrokardiyografik değişiklikler gösterebilir. Bu çalışmanın amacı AC'li hastalarda elektrokardiyografik değişiklikleri yeni parametrelerle değerlendirmektir.
Yöntemler: Çalışmaya AC 'li 34 hasta ve 30 kontrol dahil edildi. Kontrol grubu, herhangi bir kardiyovasküler ve sistemik hastalığı olmayan yaş ve cinsiyet uyumlu bireylerden oluşuyordu. Demografik ve klinik veriler kaydedildi. Elektrokardiyografik ölçümler QT aralığını, düzeltilmiş QT (QTc) aralığını, T dalgasının tepe noktası ve sonu (Tp-e), Tp-e / QT oranını ve p dalga sürelerini hesaplamak için yapıldı.
Bulgular: Çalışmamızda demografik veriler ve klinik özellikler açısından iki grup arasında anlamlı fark yoktu. QT aralığı, düzeltilmiş QT (QTc) aralığı, T dalgasının tepe noktası ve sonu (Tp-e) ve p dalgası süreleri iki grupta benzerdi. İki grup arasında p dalga dispersiyonu ve Tp-e / QT oranı açısından istatistiksel olarak anlamlı bir fark bulunmadı.
(38.0 ± 3.9 vs 37.9 ± 4.4, p: 0.930 ; 0.21 ± 0.07 vs 0.20 ± 0.09 , p: 0.260 sırasıyla)
Sonuç: Akut kolesistitli hastalar, sağlıklı kontroller ile karşılaştırıldığında elektrokardiyografide miyokard ve atriyumun benzer elektrofizyolojik özelliklerine sahiptir.

Anahtar kelimeler: Kolesistit, elektrokardiyografi, elektrofizyoloji

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*Coresponding Authors: Hasan Calis, Alanya Alaaddin Keykubat University, School of Medicine, Department of General Surgery, 07400, Alanya, Turkey, +905055361380, drhasancalis@hotmail.com

ORCİD: 0000-0003-4182-798X

INTRODUCTION

Acute cholecystitis (AC) is an acute inflammatory disease of the gallbladder which is most commonly caused by prolonged obstruction of the cystic duct [1]. The local inflammation of AC is often accompanied by systemic inflammation. Acute cholecystitis often occurs in association with gallbladder stones. It has been reported that, there is a complex relation between AC and cardiovascular disease in terms of pathophysiology and clinical presentation [2]. It is of interest to determine whether cardiovascular disease is a risk factor for AC.

Acute cholecystitis can mimic the ECG changes seen with the coronary heart disease. The electrocardiographic changes usually occurs as non spesific ST-T wave abnormalities [3]. Also AC related cardiac conduction disorder has been reported previously [4]. Soric et al. reported that AC could cause intermittent complete heart block in these patients [5].

P wave dispersion (PWD) is defined as the difference between the maximum and the minimum p wave duration and calculated from the surface electrocardiography (ECG) [6]. QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), Tp-e/QT and ratio are electrocardiographic parameters to evaluate myocardial repolarization properties [7]. These novel electrocardiographic parameters are widely used for assessing cardiac risk in several cardiovascular diseases including coronary artery disease or arrhytmia [8,9]. As it has been known that arrhytmias or non spesific ST-T wave changes may be associated with AC; we aimed to evaluate novel electrocardiographic parameters in patients with AC in this study.

PATİENTS AND METHODS

This retrospective observational study was conducted from march 2018 to february 2019. Acute cholecystitis was defined according to the Tokyo criteria which use clinical, laboratory and imaging findings for diagnosis [10]. Demographic data and clinical features were recorded. Patients with known cardiovascular disease, congenital heart disease, metabolic-endocrine disease, renal disease, hypo-hyperthyroidism, diabetes mellitus, hypertension, acute-chronic respiratory diseases, rheumatologic entities, biliary pancreatitis, cholangitis, acalculous cholecystitis, obstructive jaundice and use of drugs that can affect electrocardiographic parameters were excluded from the study. Also ECGs without clearly analyzable QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), Tp-e/QT ratio and p wave durations were excluded from the study. The study population consisted of 34 patients with acute cholecystitis and 30 healthy individuals after exclusion criterias.

-Electrocardiography: All patients had ECG on admission before treatment. A 12 lead surface ECG during sinus rhytm was obtained from each participant in supina position following 10 minutes rest with 10 mm /mV amplitude and 25 mm/s paper speed. The point of first detectable atrial deflection from the isoelectric line was defined as the onset of the P wave. Return to the isoelectric line was defined as the end of the P wave. P wave duration was measured in all 12 leads on the surface ECG in order to evaluate maximum and minimum p wave duration (p max, p min respectively) (Figure 1. Example for measurement of minimum and maximum p wave duration). The difference between p max and p min was defined as p wave dispersion (PWD). The QT interval was measured from the first deflection of the QRS complex to the end of the T wave in many as leads as possible. Hodges formula (QTc= QT+0.00175 ([60/RR]−60)) was used to define corrected QT interval [11]. The Tp-e interval was defined as the interval from the peak of T wave to the end of the T wave. Measurement of the Tp-e interval was performed from precordial leads. The Tp-e/QT ratio was calculated as Tp-e interval divided by QT interval. (Figure 2. Example for measurement of QT and Tp-e interval). The software Cardio Calipers (Iconico Inc., New York,USA) was used for electrocardiographic measurements.

-Echocardiography: Transthoracic echocardiographic examinations were performed in all participants at the left lateral decubitus position to evaluate conventional parameters with Toshiba Artida SSH-880 CV. All echocardiographic measurements were done according to the guidelines of American Society of Echocardiography [12].

Ethical Approval: This study was approved by Alanya Alaaddin Keykubat University Faculty of Medicine Clinical Research Ethics Committee.

Figure 1. Example for measurement of minimum and maximum p wave duration

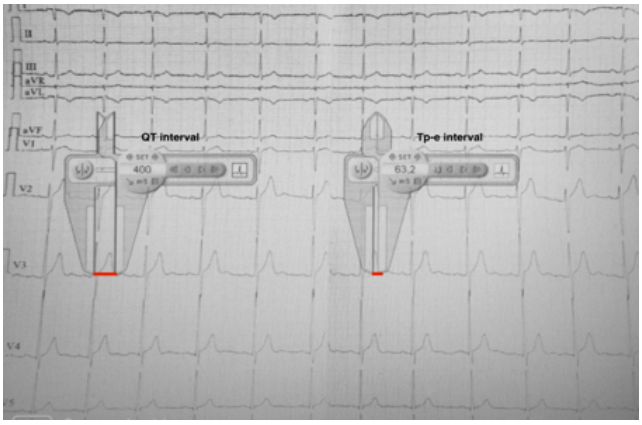

Figure 2. Example for measurement of QT and Tp-e interval

Statistic: The data were presented as mean±standard deviation (SD). The Kolmogorov-Smirnov test was used to examine if variables are normally distributed. Independent Samples t test and Mann-Whitney U test were used for the comparison of quantitative data. Chi-Square test was used for the comparison of the comparison of qualitative data. SPSS 22.0 was used for statistical analyses. P value less than 0.05 was considered statistically significant.

RESULTS

34 patients with acute cholecystitis and 30 controls were included in the study. The demographic data, clinical characteristics and echocardiographic variables of the patients and healthy controls are shown in table 1 (Table 1: Demographic, clinical and echocardiographic variables of study group).

Table 1. Demographic, clinical and echocardiographic variables of study group

Demographic and clinical variables	Control n: 30	Acute cholecystitis n: 34	P
Age, years	56.6 ± 14.0	59.2 ± 14.9	0.481
Gender, F/M	14/16	17/17	0.790
BMI, kg/m2	26.9 ± 4.4	24.9 ± 4.5	0.077
Creatinin, mg/dl	0.82 ± 0.12	0.83 ± 0.14	0.803
Potassium, mmol/L	3.9 ± 0.2	4.0 ± 0.2	0.383
Hb, g/dl	15.3 ± 0.8	14.6 ± 1.5	0.027
SBP, mm Hg	118.8 ± 8.5	121.4 ± 10.3	0.266
DBP, mm Hg	73.8 ± 6.7	73.7 ± 2.6	0.666
HR , /min	73.8 ± 8.9	71.9 ± 6.1	0.307
Echocardiographic variables			
LV EF, %	70.3 ± 5.8	69.6 ± 6.1	0.648
LAd, cm	33.1±3.1	32.2±2.2	0.148

Data are presented as mean±standard deviation values. F- female, M-male Hb – hemoglobin, SBP - systolic blood pressure, DBP - diastolic blood pressure, HR - heart rate, LAd - anterior - posterior left atrial diameter, BMI - body mass index, LV EF – left ventricular ejection fraction,

There were no significant differences between the patients and the controls in terms of age and gender distribution. Body mass index (BMI) was similiar in the two groups. Also systolic, diastolic blood pressures, heart rates were similiar in both groups.The electrocardiographic characteristics of the study groups were shown in table 2 (Table 2. Electrocardiographic variables of study group). When we compared QT interval, corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), and p wave durations, there was no statistically difference between the groups. No statistically significant difference was found between two groups in terms of p wave dispersion and Tp-e/QT ratio (38.0±3.9 vs 37.9±4.4, p:0.93; 0.21±0.07 vs 0.20±0.09, p:0.26 respectively).

Table 2. Electrocardiographic variables of study group

Electrocardiographic variables	Control n: 30	Acute cholecystitis n: 34	p
P maximum, msec	108.3 ± 4.3	109.2 ± 4.2	0.396
P minimum, msec	70.2 ± 3.3	71.2 ± 4.9	0.348
PWD	38.0 ± 3.9	37.9 ± 4.4	0.930
QT interval, msec	380.4 ± 16.7	379.2 ± 16.0	0.772
QTc interval, msec	404.6 ± 22.2	400.0 ± 17.2	0.354
Tp-e interval, msec	67.2 ± 5.7	65.5 ± 4.8	0.202
Tp-e/QT ratio	0.21 ± 0.07	0.20 ± 0.09	0.260

Data are presented as mean±standard deviation values, PWD – P wave dispersion, Tp-e – peak and the end of the T wave, QTc – corrected QT

DISCUSSION

Acute cholecystitis is one of the non cardiac conditions that has been reported to mimic the ECG changes seen with coronary heart disease [13]. Franzen et al, reported that gallbladder disease could be associated with cardiac conduction disorders [14]. The electrocardiographic changes usually occur as diffuse, non spesific ST-T wave abnormalities [15-17]. The pathophysiological mechanism underlying the electrocardiographic changes in AC patients is not clearly defined. A vagally mediated reflex called cardio-biliary reflex is thought to be the responsible mechanism. Cardio-biliary reflex is triggered by pain, inflammation and gallbladder distension. Gallbladder distension has been shown to increase plasma renin levels and decrease coronary blood flow in animal and human studies [18,19]. In animal studies, it has been reported that this reflex mechanism has an alfa adrenergic sympathetic efferent and a vagal afferent pathway [20].

Acute cholecystitis often occurs in association with gallbladder stones. Age, sex, obesity, diabetes mellitus are principal risk factors for gallstones [21]. As risk factors for gallstones and cardiovascular diseases appear to overlap, it is curious to investigate whether cardiovascular disease is a risk factor for AC. Also it has been known that cardiovascular system involvement could be seen during the course of the disease. According to our knowledge there is no previous report regarding the evaluation of novel electrocardiographic parameters in patients with acute cholecystitis.

P wave dispersion is related to prolongation of intra atrial and inter atrial conduction time as well as inhomogeneous propagation of sinus impulses. It has been reported that PWD could be used to identify patients under risk for developing atrial arrhytmias especially atrial fibrillation [22]. Moreover; it was found that PWD was associated with stable coronary artery disease and slow coronary flow [23,24]. We hypothesized that inflammatory state with the cardio-biliary reflex in the course of AC may effect atrium and therefore change the p wave parameters. However we have found no significant difference between the groups in terms of p wave durations and p wave dispersion.

QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), Tp-e/QT and ratio are used as electrocardiographic index of myocardial repolarization. It has been shown that these parameters are affected in various cardiac conditions including coronary artery disease, arrhytmia or cardiomyopathy [25-27]. Also it has been known that inflammation is potentially reversible cause QT prolongation [28]. So we evaluated QT parameters in patients with AC, and we found no significant difference between groups in terms of electrophysiological properties of myocardium.

Study Limitations: This was a retrospective study that was conducted at a single center. Our sample size was small to conduct a subgroup analysis according to Tokyo criteria classification. Intra and inter-observer variability analysis would have increased the reliability of ECG measurements.

In conclusion; patients with AC as compared to healthy controls have similiar p wave dispersion, QT interval , corrected QT (QTc) interval, peak and the end of the T wave (Tp-e), Tp-e/QT ratio on the ECG. Prospective randomized studies could provide more mechanistic insight into cardio-biliary reflex and ECG changes in patients with AC.

Conflict of Interest: The authors have no conflicts of interest relevant for this article.

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