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ORIGINAL ARTICLE

Electrocardiographic Findings of Leprosy

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ABSTRACT

Objective: The purpose of the present study was to investigate the effect of leprosy on basic electrocardiography (ECG) parameters.

Materials and Methods: A total of 66 patients including 33 patients with leprosy (mean age: 70.06 years, 24 males) and 33 control patients (mean age: 56.66 years, 15 males) were included in the study. ECG recordings of all patients were obtained, and groups were compared in terms of heart rate, PR, QT, QTc, JTc, and T peak to T end (Tp-e) durations and branch blocks.

Results: QT (391.30 vs. 367.66, p<0.01), QTc (423.57 vs. 407.15, p<0.01), and Tp-e (74.18 vs. 66.93, p<0.001) intervals were significantly prolonged in the leprosy group. The left anterior hemiblock (LAH) was observed more in patients with leprosy (42.4% in 14 patients) than in the non-leprosy group (42.4% vs. 12.1%, p<0.01). In addition, the rate of the unifascicularblock was significantly higher in the leprosy group (39.4% vs. 9.1%, p<0.01).

Conclusion: Leprosy has a significant effect on QT, QTc, and Tp-e intervals. Prolongation of the QT, QTc, and Tp-e intervals is an indicator of leprosy's effect on the cardiac autonomic system. The ratio of the LAH is also rather high, and that may be a marker of the area where leprosy is most effective on the heart.

Keywords: Leprosy, electrocardiogram, QT prolongation

INTRODUCTION

Leprosy is a contagious disease caused by the bacillus Mycobacterium leprae. The World Health Organization (WHO) reported that in 2015, 174,608 new cases were detected in 136 countries worldwide (1). It continues to have a significant global impact up to this day. The absolute mechanism of contagious leprosy is not completely known. The most common view was that the disease was transmitted by contact between persons with leprosy and healthy persons. However, the idea that leprosy is recently transmitted by the respiratory tract system has been increasing. Although leprosy affects the peripheral nerves and skin, it can cause irreversible impairment of nerve function and chronic disability (2).There are also studies showing the effects of leprosy on the cardiac autonomic system (3). The autonomic disorder in patients with leprosy can be explained on the basis of the neurotropic action of the lepra bacilli that infiltrate the nerve fibers (4). In the present study, we examined the reflections of these cardiac autonomic effects on electrocardiography (ECG).

MATERIALS and METHODS

After ethical committee approval was obtained, the Elazıg Dermatology and Leprosy Hospital records were reviewed retrospectively. A total of 66 patients, with 33 subjects with leprosy and 33 individuals without leprosy, were included in the study. The demographic features, risk factors, cardiovascular histories, and ECG and echocardiographic findings of all patients were obtained from the hospital records. The Schiller Cardiovit AT-102 Plus was used (10 mm/mV calibration and 25 mm/s velocity) for standard 12-derivation ECG recordings. Patients' ECG recordings were examined by two expert cardiologists, and in case of controversy, a third cardiologist made the decision. Only patients with lepromatous leprosy were included in the study. The ECG recordings were compared in terms of heart rate; PR, QT, QTc, and JTc intervals; and T peak to T end (Tp-e) duration. The ECG recordings of the groups were compared based on the frequencies of the right bundle branch block, left bundle branch block, left anterior hemi block (LAH), left posterior hemi block (LPH), first-degree atrioventricular (AV) block, unifascicular block, bifascicular block, trifascicular block, and fragmented QRS. QTc intervals were calculated using the Bazett formula. QT interval is calculated as the interval from the beginning of the QRS to the end of the T wave. JTc is

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defined as the corrected JT interval and is calculated as QTc minus QRS duration (JTc=QTc−QRS duration). Tp-e interval is defined as the interval from the peak of T wave to the end of T wave. Fragmentation on ECG is defined as the presence of an additional R wave or presence of a notch in the tip of the S wave or more than one large R′ wave in two consecutive derivations (5). Patients with drug use that could affect ventricular repolarization were excluded from the study.

Statistical Analysis

Statistical analysis was performed using the SPSS 15.0 for Windows Evaluation Version statistical package. Continuous variables were presented as mean±standard deviation. Categorical variables were expressed as frequencies. Differences between the two groups according to continuous variables were determined by the independent samples t-test. Categorical variables were compared by chi-squared or Fisher's exact test. A p-value of <0.05 was accepted as statistically significant.

RESULTS

The mean age of the leprosy group was significantly higher than that of the non-leprosy group (70.06±13.74 vs.56.66±13.52 years, p<0.01). The average duration of illness in the leprosy group was 43.57±15.11 years. The proportion of male gender was significantly higher in the leprosy group (24(72.7%) vs.15(45.5%), p=0.024).There are no statistically significant differences between the groups related to diabetes mellitus, hypertension, smoking, and coronary artery disease(CAD).Of the patients, 11 (33.3%) had limb amputation(4 finger and 7 limb amputations).Hand, foot, eye, and nose involvement in 2 patients; hand, foot, and eye involvement in 18 patients; foot and eye involvement in 4 patients; and foot and hand involvement in 4 patients were observed. Only eye involvement in 3 patients, only foot involvement in 1 patient, and only hand involvement in 1 patient were observed. There was no statistically significant difference between the groups in terms of heart rate, PR period, JTc duration, LPH, first-degree AV block, bifascicular block, trifascicular block, QRS fragmentation, and left and right branch block frequencies on ECG (Table 1). QT (391.30 vs. 367.66, p<0.01), QTc (423.57 vs. 407.15, p<0.01), and Tp-e (74.18 vs. 66.93, p<0.001) intervals were significantly longer in the leprosy group than in the non-leprosy group. The LAH was observed more in patients with leprosy (42.4% in 14 patients) than in the non-leprosy group (42.4% vs. 12.1%, p<0.01). In addition, unifascicular block ratio was significantly high in the leprosy group (39.4% vs. 9.1%, p<0.01).When patients with leprosy were examined according to sex, there was no statistically significant difference between the groups based on ECG findings (Table 2).

Table 1. Baseline characteristics and ECG findings of patients with and without leprosy

Variables	Leprosy (+) (n=33)	Leprosy (–) (n=33)	p
Age(years), mean (SD)	70.06±13.74	56.66±13.52	<0.01*
Gender (male), n (%)	24 (72.7%)	15 (45.5%)	0.024*
Diabetes mellitus, n (%)	3 (9.1%)	2 (6.1%)	1
Hypertension, n (%)	15 (45.5%)	8 (24.2%)	0.071
CAD, n (%)	4 (12.1%)	2 (6.1%)	0.672
Smoking, n (%)	8 (24.24%)	11 (33.33%)	0.415
Heart rate (bpm)	71.95±17.72	75.18±11.10	0.300
PR (ms)	162.00±28.89	154.12±23.07	0.225
QT (ms)	391.30±38.80	367.66±24.20	<0.01*
QTc (ms)	423.57±25.49	407.15±19.96	<0.01*
LAH, n (%)	14 (42.4%)	4 (12.1%)	<0.01*
LPH, n (%)	1 (3.0%)	2 (6.1%)	1
First-degree block, n (%)	6 (18.2%)	2 (6.1%)	0.258
Unifascicular block, n (%)	13 (39.4%)	3 (9.1%)	<0.01*
Bifascicular block, n (%)	3 (9.1%)	4 (12.1%)	1
Trifascicularblock, n (%)	0 (0%)	0 (0%)	
LBBB, n (%)	2 (6.1%)	0 (0%)	0.492
RBBB, n (%)	4 (12.1%)	3 (9.1%)	1
QRS fragmentation, n(%)	5 (15.15%)	2 (6.06%)	0.477
JTc (ms)	314.36±32.33	313.87±22.34	0.94
T peak to T end interval(ms)	74.18±11.03	66.93±8.72	<0.01*

Independent samples t-test, chi-squared test, and Fisher's exact test (continuous variables are expressed as mean±SD or median, and categorical variables are expressed as n%).
*p<0.05 was accepted statistically significant and marked bold
CAD: coronary artery disease; LAH: left anterior hemi block; LPH: left posterior hemiblock; LBBB: left bundle branch block; RBBB: right bundle branch block.

DISCUSSION

Today, leprosy continues to be a significant health problem. Despite advances in its diagnosis and treatment, there were 174,608 new cases reported in 2015 (1). It shows how this disease continues to be an actual threat. Owing to the variation of its immunopathology, it has wide clinical results (6). Although primary involvement occurs in the skin and peripheral nervous system, the cardiac system is also affected by this disease, and follow-up of the cardiac system requires special attention. In the present study, we showed that leprosy is an important cause of QT, QTc, and Tp-e interval prolongation. In addition to the findings of other studies previously conducted, we showed that in leprosy, most of the involvement occurs in the left anterior branch. The fact that LAH is detected in 42.4% of patients with leprosy is rather remarkable.

Therefore, what causes the QT and QTc interval prolongation and the high rates of LAH? Such cardiac effects of leprosy have been evaluated in earlier studies, and it was shown that leprosy causes cardiac amyloidosis (7), and that it affects the cardiac autonomic system (5-10).Thus, is it possible that the only cause of the high frequency of LAH and the prolongation of QT and QTc in leprosy could be due to these reasons? In some studies previously conducted, it has been shown that the QT and QTc intervals are not prolonged in amyloidosis (11, 12), and in echocardiographic examinations of our patients, we did not follow the appearance compatible with amyloidosis. In this case, we think that the reason of the QT, QTc, and Tp-e interval prolongation is mostly the

Table 2. ECG findings according to sex in patients with leprosy.

Variables	Male (n=24)	Female (n=9)	p
Heart rate (bpm)	69.25±13.09	79.22±13.35	0.300
PR (ms)	159.16±31.42	169.55±20.33	0.062
QT (ms)	397.70±42.22	374.22±21.15	0.123
QTc (ms)	421.87±25.62	428.11±26.09	0.540
LAH, n (%)	11 (45.83%)	3 (33.33%)	0.698
LPH, n (%)	1 (4.16%)	0 (0%)	1
First-degree block, n (%)	4 (16.66%)	2 (22.22%)	1
Unifascicular block, n (%)	10 (41.66%)	3 (33.33%)	1
Bifascicular block, n (%)	3 (12.50%)	0 (%)	0.545
Trifascicularblock, n (%)	0 (0%)	0 (0%)	
LBBB, n (%)	2 (8.33%)	0 (0%)	1
RBBB, n (%)	4 (16.66%)	0 (0%)	0.555
QRS fragmentation, n (%)	4 (16.66%)	1 (11.11%)	1
JTc (ms)	308.25±31.95	330.66±28.89	0.076
T peak to T end interval (ms)	75.00±10.32	72.00±13.15	0.495

Independent samples t-test, chi-squared test, and Fisher's exact test (continuous variables are expressed as mean±SD or median, and categorical variables are expressed as n (%).
$p<0.05$ was accepted statistically significant
LAH: left anterior hemi block; LPH: left posterior hemi block; LBBB: left bundle branch block; RBBB: right bundle branch block.

involvement of the autonomic nervous system. In patients with leprosy, the parasympathetic system involvement occurs before the sympathetic system involvement and is more severe. The severity of neuropathy is directly correlated with the duration of the disease (13). These disorders that develop in the autonomic system are explained by the neurotropic effects of the leprosy bacilli that infiltrate the sympathetic and parasympathetic fibers. The autonomic and intrinsic cardiac involvement affects ventricular repolarization and prolongs QTc and Tp-e intervals (14, 15). It is now well known that QT and QTc prolongation causes life-threatening arrhythmias, and it has also started to be realized that LAH is important regarding cardiac comorbidities. In studies previously conducted, LAH has been found to be associated with increased cardiac death in patients with suspicion of CAD and increased mortality in the hospital and during the 6-monthfollow up in patients with acute coronary syndrome (16, 17). Hence, in patients with leprosy, in addition toQT and QTc prolongation, LAH that occurs at high rates is also an important ECG finding that should be considered, and it is highly important to monitor the QT and QTc intervals on ECG to predict arrhythmic events in these patients. On the other hand, recent studies showed that prolongation of the Tp-e interval is a marker of ventricular arrhythmias, increased risk of mortality in congenital long QT syndromes, hypertrophic cardiomyopathy, and also in patients with myocardial infarction who underwent primary percutaneous coronary intervention (18-21). Prolongation of the Tp-e interval indicates a period of potential vulnerability to reentrant ventricular arrhythmias (22). Therefore, it is clinically important that we have shown that the Tp-e interval is prolonged in patients with leprosy, and it shows us that we should be careful about cardiac complications, especially arrhythmic events.

In the present study, we could not find a statistically significant difference between the groups in terms of CAD; however, contrary to our study, it has also been shown that the frequency of CAD is higher in patients with leprosy at old ages, and that some deaths among patients with leprosy are due to cardiac causes (23). In addition, Yajima et al. suggested that paralytic arterial changes in patients with leprosy can promote ischemic cardiac disease and coronary sclerosis (24). However, we believe that further research is needed to make a definite decision in this regard.

The other important point is why the involvement most commonly occurs in the left anterior branch in leprosy. Is the most sensitive conduction area to the effects of leprosy on autonomic functions the left anterior branch, or is it that leprosy's intrinsic cardiac involvement most commonly occurs in this area? Does this ECG finding show the area where leprosy is most effective in the heart? To our knowledge, these questions do not have complete answers. Unfortunately, our study cannot provide a complete explanation to these questions because it does not include histopathological evaluation. There is a need for further studies on this subject, and our study could serve as a guide for research onthis subject.

Study Limitations

Although the present study has presented these findings, it has several limitations. Its limitations include a single-center study, the low number of patients, the lack of histopathological results, and the lack of long-term follow-up of patients with QT prolongation and those who developed LAH. Furthermore, the statistical significance of the age difference between the groups may have affected our results.

CONCLUSION

As a result, leprosy is a multisystem disease with significant cardiac effects. It has a significant effect on QT, QTc, and Tp-e intervals. Prolongation of the QT, QTc, and Tp-e intervals is an indicator of leprosy's effect on the cardiac autonomic system. The ratio of the LAH is also rather high, and that may be a marker of the area where leprosy is most effective on the heart. However, further research is needed in this regard.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Erciyes University.

Informed Consent: Informed consent was obtained from the parents of the participants.

Peer-review: Externally peer-reviewed.

Author Contributions: Conceived and designed the experiments or case: EY, OS, BD. Performed the experiments or case: EY, BD, OS. Analyzed the data: EY, MNB. Wrote the paper: EY, OS, BD, MNB. All authors have read and approved the final manuscript.

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