

Electrocardiographic Abnormalities in Patients Bitten by Scorpions

Akrep Sokmalarında EKG Değişiklikleri

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ABSTRACT

OBJECTIVE: The purpose of this study is to examine the electrocardiographic features of patient stung by scorpions.

METHODS: Seventy six patients stung by scorpions were gathered in the study. 12 lead derivations electrocardiography (ECGs) was performed to all patients. The ECG which were performed when the patients had maximum (grade 3) pain were obtained for determination. The determined parameters were: PR segment and QRS duration, QTmin, QTmax, QTc, QT dispersion (QTd) intervals, minimum P wave duration (PWmin), maximum P wave duration (PWmax) and P wave dispersion (PWd).

RESULTS: Seventh six patients (37 males and 39 females, mean age: 33,7±14,7 years) were included in this analysis. Heart rate, QRS duration, QTc, QTd, PWmin, and PWd which we found were 84,5±13,8 beat/min, 98,8±11,8 msn, 412±27,4 msn, 412±27,4 msn, 412±27,4msn and 41,4±19,7 msn respectively.

CONCLUSION: Scorpion sting lead electrocardiografic variability. The most common changes were ST changes, sinus tachycardia, atrial ectopic beat, bradycardia, and ventricular ectopic beat.

Key Words: Electrocardiografic variability; Heart rate; Scorpion sting; S-T changes; QT dispersion

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ÖZET

AMAÇ: Bu çalışmada amaç akrep sokması hastalarında EKG değişikliklerini belirlemektir.

METOD: Akrep sokması olan 76 hasta çalışmaya alındı. Tüm hastalara 12 derivasyon EKG çekildi. EKG hastaların en çok ağrılarının olduğu (Grade 3) anda çekildi. İnceleme parametreleri: PR segment ve QRS mesafeleri, QTmin, QTmax, QTc, QT uzaması (QTd), minimum P dalga süresi (PWmin), maksimum P dalga süresi (PWmax) ve P dalga uzaması (PWd) idi.

SONUÇLAR: 76 hasta (37 erkek ve 39 kadın, yaş ortalaması: 33,7±14,7) çalışmaya alındı. Nabız, QRS mesafesi, QTc, QTd, PWmin, ve PWd süreleri sırayla 4,5±13,8 atım/dk, 98,8±11,8 msn, 412±27,4 msn, 412±27,4 msn, 412±27,4msn and 41,4±19,7 msn idi.

SONUÇ: Akrep sokmalarında EKG değişiklikleri olur. En çok değişiklik ST değişikliği, sinüs taşikardisi, atrial ektoptik atım, bradikardi ve ventriküler ektoptik atımlardır.

Anahtar Kelimeler: Elektrokardiyografik değişiklik, Nabız, Akrep Sokması, S-T değişiklikleri, QT uzaması

INTRODUCTION

Scorpion envenomation is common in tropical and subtropical regions. A direct effect of scorpion venom on the myocardial has also been shown in several studies. Finally, cardiac dysfunction might be due to myocardial ischemia, whether related to massive catecholamine outpouring or coronary abnormality⁽¹⁾.

Electrocardiographic abnormalities are frequently recorded on admission or several hours later⁽²⁾. Sinus tachycardia is initially recorded in the majority; however sinus bradycardia may be present in 24% of the victims. Bizarre, broad notched, biphasic T wave changes with additional ST elevation or depression in the limb and precordial leads are recorded, sometimes accompanied by beat-to-beat T wave abnormalities⁽³⁾ followed by the appearance of tiny Q waves in the limb leads, consistent with acute myocardial infarction-like pattern; occasionally electrical alternant of the QRS was recorded; the QTc was prolonged in the majority of patients and a transient deviation of the QRS frontal axis to the left or right accompanied by incomplete RBBB was also observed. Conduction abnormalities such as LBBB or different degrees of AV block were rarely recorded⁽³⁾.

Rhythm disturbances of short duration such as atrial fibrillation, atrial or ventricular premature depolarisations, single or bigemini, or ventricular tachycardia are rarely observed and do not contribute to death or heart failure⁽³⁾. Most of the ECG changes persist for several days; in the occasional patient tall, peaked T waves in the precordial leads without ST abnormalities persist for several weeks.

Although the yellow scorpion is considered the most dangerous of the species since it causes cardiac toxicity, several case reports have described temporary electrocardiographic changes following envenomation by the black scorpion⁽⁴⁾.

The aim of the present study was to examine the electrocardiographic changes in patients presenting with envenoming following a scorpion sting.

PATIENTS AND METHODS

Seventy six patients (older than 16 years old), who had admitted to emergency department of Batman State Hospital, Turkey, due to scorpion sting between April 2006 and September 2006 were gathered for this study. The study was constructed prospectively. The protocol was kept in accordance to the Helsinki Declaration and approved by the scientific ethic administrative board.

Repeat 12 derivation electrocardiography (ECGs) were obtained per 6 h during admission from all patients. Only the ECG that was obtained from the patients when their pain was at the highest level was recorded for determination.

Minimum QT duration, maximum QT duration and QT dispersion were measured. QT dispersion was calculated as the difference between maximum QT duration and minimum QT duration (QT dispersion= maximum QT duration-minimum QT duration). Increased QT dispersion (QTd) is an indicator of heterogeneous ventricular repolarization and is

useful for prediction of lethal arrhythmia such as ventricular tachycardia⁽⁵⁾.

Minimum P wave duration, maximum P wave duration and P wave dispersion were calculated. P wave dispersion was calculated as the difference between maximum P wave duration and minimum P wave duration (P wave dispersion= maximum P wave duration-minimum P wave duration).

The P wave of the electrocardiogram may show alterations that can be associated with atrial arrhythmias⁽⁶⁾. Prolonged P wave duration and increased P wave dispersion have been reported to an increased risk for atrial fibrillation⁽⁷⁾.

Corrected values (QTc, QpTc) were calculated from these values according to the Bazett formula: (QTc=QT/QR-R, Q peakTc=QpT/R-R (sec). Additionally, QpeakT values were found by measuring the interval between the initial point of the QRS complex and the highest point (peak) of the T wave.

The reasons for the dismissing from the study were smoking, history of any cardiovascular disease including coronary arterial diseases, valvular heart disease, myocardial or pericardial diseases, arrhythmia and diabetes mellitus. Also, the persons who had infection or auto-immune diseases, neo-plastic diseases, kidney/lung/liver diseases, major depressions, and the person who had no any pain or light but non increased pain at admission time were dismissed from the study.

Statistical analysis:

SPSS software package (SPSS 15; SPSS Inc., Chicago, IL, USA) was used for statistical analyses. The data were analyzed using Student's t-test and the numeric data were expressed as the mean \pm standard deviation. Chi-square test and the results were expressed in percentages.

RESULTS

The mean values and statistical comparisons of 76 patients are presented in Table 1. Seventy six patients (37 males and 39 females, mean age; 33,7 \pm 14,7 years) were included in this analysis. The ECG which were performed when the patients had maximum (grade 3) pain were obtained for determination. Heart rate (84,5 \pm 13,8 beat/min), QRS (98,8 \pm 11,8 msn), QTc (412 \pm 27,4 msn), QTd (412 \pm 27,4 msn), PWmin (412 \pm 27,4 msn) and PWd (41,4 \pm 19,7 msn) were found

In patients, sinus tachycardia, atrial ectopic beat, ventricular ectopic beat, sinus arrhythmia, ST changes, LBBB, RBBB, first-degree AV block, LAHB, LPHA that were not needed treatment were 17,1%, 2,6%, 13,2%, 2,6%, 7,9%, 13,2%, 1,3%, 2,6%, 6,6%, 6,6%, and 2,6% respectively.

Of victims, 26% were stung by the yellow scorpions that are considered to be the most dangerous of the species, while the rest (74%) were stung by black scorpions that are thought to be less dangerous. Acute pulmonary edema and cardiac tamponade was not developed in any patients. All patients were discharged without complications.

Table 1. Comparison of ECGs findings of the patients

	n=76
Age (years)	33,7±14,7
Gender (Female/Male) (n)	39/37
Sinus tachycardia (n/%)	13/ %17,1
Heart (Rate beat/min)	84,5±13,8
Atrial ectopic beat (n/%)	10/ %13,2
Ventricular ectopic beat (n/%)	2 /%2,6
Bradycardia (n/%)	2 /%2,6
Sinus arrhythmia (n/%)	6 /%7,9
ST changes (n/%)	10 /%13,2
LBBB (n/%)	1/ %1,3
RBBB (n/%)	2 /%2,6
I. AV block (n/%)	5 /%6,6
LAHB (n/%)	5/ %6,6
LPHB (n/%)	2/ %2,6
PR duration(msn)	159,1±34,1
QRS duration(msn)	98,8±11,8
QTmin (msn)	342,4±32,8
QTmax(msn)	377,1±33,4
QTc(msn)	412±27,4
QTd(msn)	36,3±21,5
Pmin wave duration (msn)	68,4±19,3
Pmax wave duration (msn)	105,9±21,1
PWd (msn)	41,4±19,7
QpeakT (msn)	87,1±20,1

QTd:QT dispersion, PWd:P wave dispersion

DISCUSSIONS

The scorpionism and its consequences are an actual public health problem in several parts of the world; especially in north-Saharan Africa, Sahelian Africa, South Africa, Near and Middle-East, South India, Mexico and South Latin America, east of the Andes⁽⁸⁾. Approximately 1500 species of scorpions are described. About thirty of them are recognized as potentially dangerous for humans⁽⁹⁾. Approximately 94% of the accidents occur during the night at homes especially in rural areas, and 88% do not require any hospitalization⁽⁸⁾. Climatic conditions, dryness and heat, are also important risk factors⁽¹⁰⁾. The effects of the stings depend on the delivery dose of the scorpion, the age of the offender, the season, and the size of the victim⁽¹¹⁾.

Adults and among them males are most frequently stung by scorpions. However, envenomations are more severe in children in whom mortality is dramatically higher than in adults⁽³⁾. The death can occur early due to cardiovascular collapse. The incidence is underestimated resulting in the absence of exhaustive report of the cases; mortality is probably better known. More than 1,200,000 scorpion stings occur annually while the number of deaths could exceed 3250⁽⁹⁾. Average case fatality rate is 0.27%⁽⁹⁾. Soker et al⁽¹²⁾ reported a higher mortality rate (12.5%) from west and southeastern part of Anatolia among 64 children patients

with scorpion stings. In contrast, in our study no deaths were recorded among the 76 cases from our region. We had no patients younger than 16 years old, and the female were stung more frequently (51,3%) than the male in our study. None of our patients needed hospitalization; all of them were observed less than 36 hours. Of the victims, 43% occurred at night, and the majority of (78%) stings occurred in the warmest months (July and August) in present study.

The pathogenesis of cardiac dysfunction and myocardial damage secondary to scorpion envenomation had largely been the subject of debate in the past. The most accepted hypothesis was the increased catecholamine circulating secondary to a direct stimulatory effect of the venom on the adrenals and on sympathetic nerve endings. This hypothesis was confirmed by some clinical and experimental⁽¹³⁾ studies. In effect, it is possible that the venom affected the myocardial cell membranes directly, altering its permeability as well as electrical properties, and through abnormal electrolytes fluxes and shifts, causes functional damages⁽¹⁾. However the myocardial dysfunction may be due to myocardial ischemia⁽¹⁴⁾. This hypothesis was advanced on some clinical, electrocardiographic, echocardiographic⁽¹⁵⁾, and radionuclide⁽²⁰⁾ studies.

Gueron et al⁽¹⁶⁾ described five patients who were stung by yellow scorpions and developed acute congestive heart failure with pulmonary edema and ECG signs of acute myocardial infarction. These changes reversed to normal within 48 hours. Sclarovsky et al⁽¹⁷⁾ reported another patient who was envenomated by a yellow scorpion developed hypertension and ST-T electrocardiographic changes. These changes returned to normal following treatment with alpha and beta blockers. Gueron et al explained in a different study⁽³⁾ that the shock syndrome is a common observation; it may precede but usually follows the hypertensive phase, occasionally accompanied by bradycardia; pulmonary edema and cardiogenic shock may coexist in the same patient. It was also reported in this study that, the incidence of pulmonary edema ranged from 7% to 46% and cardiac arrest rate was 7%⁽³⁾. It is reported in many studies⁽¹⁷⁾ that, the clinical signs of involvement of cardiovascular system are tachycardia (rarely bradycardia with hypotension) with hypertension, in a large number of the victims. Alpay et al⁽¹⁸⁾ evaluated the ECG findings in two cases; in first case they had shown sinus rhythm with normal PR and QT intervals, presented 1 mm ST depression on precordial and extremity derivations where 2 mm ST elevation was found on aWR. Sinus tachycardia, U wave and mild QTc elongation (QTc=0.46 sn) was found in ECG of the second case.

QTd is related to serious arrhythmia and sudden cardiac death⁽¹⁹⁾. In many studies, it is accepted that regional differences in repolarization (QTd) of the heart triggers these events⁽²⁰⁾. QT disturbed regional repolarization of ventricle⁽²⁰⁾, namely, it reflects homogeneity disturbance (inhomogeneity) in the repolarization process⁽²¹⁾ Alan et al⁽¹⁹⁾ thought that, persons who have been bitten by scorpions, myocarditis could develop, homogeneity of myocardium could be disturbed due to inflammation or toxic effects in myocardium, and

arrhythmias may occur through QTd. Therefore they examined QTd in patients. They did not detect a significant difference in QT and QTd value patients and control group. In our study QRS, QTd, and PWd were found to be statistically significant. There were no cases of hypersensitivity reactions, cardiogenic shock and pulmonary edema in present study. All patients were discharged with recovery.

Cheema et al ⁽²²⁾ reported that epinephrine and norepinephrine extended the maximum period of P wave. It was reported by Tukek et al ⁽²³⁾ that, the increase in sympathetic activity causes increasing in P dispersion. The P wave of the electrocardiogram may show alterations that can be associated with atrial arrhythmias ⁽⁶⁾. The P wave dispersion was not determined in previous studies due to scorpion stings. Our study is the first in this subject. We think that, the significant difference between P wave dispersion and minimum P wave period is related to both increased early atrial beat number and also increased sinus arrhythmia. This condition is related to the sympathetic activity that caused by scorpion venom.

Bouaziz et al ⁽²⁴⁾, reported that, the most observed abnormalities in electrocardiogram were sinus tachycardia (84.8%) (>120/min in children and 90/min in adult patients) and T-Wave changes (17.8%). Other ECG abnormalities were also observed including ST segment depression or elevation (15%), and sinus bradycardia (0.4%). Also, it was determined in this study that, of patients, 61.5% had a pulmonary edema, while 20.5% had a cardiogenic shock ⁽²⁴⁾. Bahloul and his colleagues ⁽¹⁴⁾ made a study to determine the myocardial ischemia in six patients with severe scorpion envenomation. In this study the most common abnormality observed in ECG was tachycardia (>110 beat/min) (100%). 1/3 of patients improved cardiogenic shock. Other ECG abnormalities were also observed, including ST segment depression or elevation observed in two patients, T-wave change was observed in four patients and right bundle branch block in one. In our study, the most common ECG abnormality was sinus tachycardia. The rate of patients with bradycardia and ST-T changes were similar to the literature.

In Blum and his colleagues's ⁽⁴⁾ study the ECG demonstrated a normal sinus rhythm. There were deep large inverted T waves in leads II, III, and AVF, with huge U waves in precordial leads V1-V4 ⁽⁴⁾. In another study that was made by Bentar et al. ⁽²⁵⁾, cardiac problems rate and ECG abnormalities was reported as 23,1% and 13,7% respectively.

CONCLUSIONS

In our study, the most common ECG abnormality was sinus tachycardia. Other ECG abnormalities were also observed, including ST segment changes, bradycardia, AV block, LBBB, and RBBB. QRS, QTd, and PWd were found to be statistically significant. The most common changes are ST changes, sinus tachycardia, atrial ectopic beat, bradycardia, and ventricular ectopic beat.

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