

## Correlation between seizure in children and prolonged QT interval

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### Original Article

#### Abstract

**BACKGROUND:** Long QT is a cardiac electrical disorder. One of the symptoms of long QT caused by fatal ventricular arrhythmia is seizure. In some studies it was indicated that up to 35% of seizures induced by long QT may be misdiagnosed as other causes of seizure.

**METHODS:** In a case-control study, patients experiencing primary seizure with unknown etiology and referring for clinical diagnosis were selected as the case group. The control group consisted of patients hospitalized for other reasons except seizure. Corrected QT Interval (QTc) was measured for each patient on an electrocardiogram, and the two groups were compared. Long QT was defined as a QT more than 0.46 seconds.

**RESULTS:** Among 508 subjects who were recruited in this study 254 children were in the case group and 254 were in the control group. There were 66 children experiencing seizure and long QT in the case group. In the control group, 48 children with long QT were observed; the difference was statistically significant ( $P = 0.02$ ). Syncope and sudden death were not significantly different between the two groups.

**CONCLUSION:** The present study showed that children with unknown causes of seizure have more frequently long QTc, which implies the possibility of an arrhythmic origin of some seizures. Therefore, it is advised to get an electrocardiography for patients with unknown causes of seizure.

**Keywords:** Seizure, Children, Long QTc

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#### Introduction

Long QTc is one of the cardiac electrical disorders caused by prolonged ventricular re-polarization which can be acquired either by drugs, such as anti-arrhythmia or three-ring drugs, or appears congenitally.

A normal QTc is less than 0.44 seconds. When QTc is equal to or more than 0.46 seconds, it is considered as long QT Syndrome.<sup>1</sup> Long QT syndrome (LQTS) occurs in about 1 in 2500 of the general population.<sup>2</sup> The clinical symptoms of long QT differ from the classical symptoms of absolutely long QT to sub-clinical forms which have long borderline QT. It was indicated that long QT and fatal ventricular arrhythmias were the cause of the seizures, and have been controlled by suitable treatment.<sup>3</sup>

Other studies conducted at the Neurology Department of The University of California indicated that long QT may emerge as seizure or epilepsy convulsion, but by early diagnosis sudden death can

be avoided.<sup>4,5</sup> If an EKG is taken, this Syndrome can easily be diagnosed and be taken care of.<sup>6</sup>

Investigations carried out in the year 2010 showed that one of the most important complaints in LQTS was syncope and seizure. Research on 1059 patients with syncope or seizure showed that a large number of patients suffering from this complain that "they have been under treatment with beta-blocker for a long time due to wrong diagnosis".

Patients who suffer from convulsions complain that "The treatment with beta blocker has been longer, caused more errors, and has a higher percentage of exposure to deadly disorders and fatal heart attack than other treatments".<sup>7</sup>

In some studies, misdiagnosis between Long QT, and arrhythmia caused by neurological seizure has shown to be up to 35%. Therefore, initial EKG has been recommended.<sup>8</sup> In one study, the possibility of misdiagnosis has been determined to be 20-30%.<sup>9</sup>

A twenty one year old woman was diagnosed

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with ventricular tachycardia after experiencing seizures with high fever. By taking her EKG it was found that signs of Brugada during fever were observed in the patient.<sup>10</sup> Therefore, in order to prevent an incorrect diagnosis and delay in making the correct diagnosis, EKG recording should be performed for every patient presenting with a seizure, considered to be of epileptic origin, not only at the beginning of the disease but also when fits occur in spite of antiepileptic treatment.<sup>11</sup>

A recent study showed that sudden loss of consciousness can be caused by syncope or epileptic seizure, which therefore requires a diagnostic work-up including cardiological and neurological examinations. Cardiac channelopathies such as LQTS may be associated with seizures, suggesting a possible link between cardiac and cerebral channelopathy.<sup>12</sup>

On the whole, in all the studies mentioned above patients experiencing seizure referring to the emergency room are diagnosed with febrile seizure and hospitalized. For this reason, a study that determines LQTS among these patients was conducted. The prevalence of long QT among patients with febrile seizures was studied. In addition, the need for performing EKG as a screening test was examined.

### Materials and Methods

All those patients who had experienced seizure without any specific cause, and all those patients without any history of seizures referring to Amirkabir Hospital of Arak, Iran, were included in the case and control groups, respectively. The need to attain both an accurate examination and EKG to diagnose the cause of their complaints was clarified for patients. The patients were also assured that their information would remain confidential.

Sample size was estimated to be 254 subjects for

each group. The aim of the present study was to determine the association of long QT of hospitalized children aged 1-12 years with epilepsy. The primary examinations showed neither any evidence of secondary causes, such as hypoxia and hypocalcaemia, nor any signs of known neurological injuries. Moreover, no evidence of secondary causes was found in clinical examinations. Patients in the case group were also included in the study seeing that many cases of seizures lead to fever; additionally, cases of seizures with cardiac etiology may emerge following a fever. Hence, seizure patients who had a fever were also included in the case group. Patients of the control group consisted of children aged 1-12 years hospitalized due to reasons other than seizure.

A questionnaire collecting information about patient's age, gender, family history of seizure, family history of heart disease, family history of sudden death, family history of syncope of children, type of delivery, drugs prescribed for the children, and also drugs used by the mothers during breast feeding was completed in both case and control groups.

A twelve lead EKG was taken for patients of both groups. The QT and RR were measured and calculated using the QTc Bazett Formula by a cardiologist. The SPSS software was used for statistical analysis using the chi-square test and logistic regression for data analysis.

### Results

508 subjects were recruited in this study; 254 children were in the case group and the same number of children were in the control group. In each group 142 were male (55.9%) and 112 were female (44.1%). There was no statistically significant difference between gender and QTc interval. The gender distribution and different levels of QT is presented in table 1.

**Table 1.** Frequency distribution of different QTc levels of males and females

Group		Female	Male	Total	
Case	QT Interval	< 0.044	74	101	175
		0.44-0.46	6	7	13
		0.46 <	30	36	66
Control	QT Interval	< 0.044	79	100	179
		0.44-0.46	10	17	27
		0.46 <	20	28	48

In the case group, 175 children (34.4%) had a QTc level of 0.44 seconds or less. 64 children (12.6%) had a QTc level of 0.44-0.46 seconds. 66 children (13%) had a QTc level of more than 0.46 seconds. Regarding the control group, 178 children (35%) had a QTc level of 0.44 seconds or less. 71 children (14%) had a QTc level of 0.44-0.46 seconds. 48 children (9.4%) had a QTc level of more than 0.46 seconds. The difference in prolonged QT between case and control groups (13% vs. 9.4%) was statistically significant ( $P = 0.02$ ). Three children in the case group and two in the control group had a previous history of syncope according to their parents, but this was not statistically significant.

There were two cases of sudden death among the family of the patients in the case group, but there was no record of this among the immediate family of the control group, the difference was not statistically significant.

### Discussion

No significant difference was observed between men and women in terms of QTc in previous studies. In a study conducted on 328 families, higher rates of syncope and cardiac arrest were seen among probands (first family members who had long QT), which were mostly young females.<sup>13</sup>

In a study in 1998 on clinical presentation related to gender of proband patients, 70% of the patients were females, but it was presented earlier in men.<sup>14</sup> The main difference between the present study and the studies previously stated was that they were conducted on patients having long QT, whereas the present study was conducted on patients experiencing seizure. In addition, more males were included in the present study.

In a study on 287 patients in seven different countries, it was revealed that long QT emerged in 9% of cases by cardiac arrest, 26% by syncope, and 10% by seizure.<sup>15</sup> This shows that long QTc probably leads to seizure. Another study conducted on patients with long QTc indicated that 50% of the patients had no symptoms; as a result, any young patient admitted to hospital with seizure uncontrolled by medication should be evaluated for long QTc.<sup>16</sup> Another study noted that the LQTS in young patients can easily be mistaken for seizure.<sup>17</sup>

Overall, these studies show that one of the symptoms of long QT is seizure and many of these cases are discovered incidentally; hence, it seems necessary to take a test for long QTc on cases admitted for seizure. The present study confirms

that the seizure group had a longer QT than the control group. Therefore, it seems helpful to take an EKG for young patients being admitted for seizure.

The present study showed no significant statistical difference in syncope and sudden death between case and control groups. On the other hand, the previous studies were carried out on patients with long QTc, consequently numerous syncope and deaths were observed.

It should be noted that there were some limitations, such as fever among the patients of the case group, which was discussed earlier in the method section. Another limitation was the lack of extensive analysis, such as CT-scan to rule out secondary causes of seizures. In conclusion, findings of the present study imply that an EKG should be taken on young patients experiencing seizures with unidentified causes.

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### Conflict of Interests

Authors have no conflict of interests.

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