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Resuscitation of sudden cardiac death caused by acute epileptic seizures: A case report

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ABSTRACT

Symptomatic long QT syndrome in pediatric patients is a life-threatening condition. Sometimes, this pathology can be misdiagnosed and erroneously managed as generalized epilepsy due to similar clinical manifestations. The presented case discusses a 13-year-old female patient with generalized epilepsy since the age of 4, admitted for two episodes of resuscitated cardiac arrest due to *torsades de pointes* and ventricular fibrillation. The final diagnosis of congenital long QT was established and due to the patient's high-risk profile for future cardiac events, implantable cardiac defibrillator was subsequently indicated. Early recognition of congenital long QT and timing of cardiac therapy were crucial and potentially lower the incidence of fatal dysrhythmias commonly associated this condition. In high-risk patients, both medical and interventional therapy can be life-saving.

1. Introduction

Congenital long QT syndrome (LQTS) is a genetic channelopathy characterized by delayed ventricular repolarization predominantly reflected on the electrocardiogram (ECG) as QT interval prolongation.

This specific condition predisposes to potentially fatal dysrhythmias such as ventricular fibrillation or *torsades de pointes* (TrP) clinically manifesting as syncope and seizures and leading to sudden cardiac death (SCD) in young and undiagnosed patients.

2. Case presentation

In April 2015, a 13-year-old female patient with a history of generalized epilepsy since the age of 4, with previous neurologic treatment including two anti-epileptic drugs (valproate and levetiracetam) was referred to the emergency department for further investigations. She presented two recent episodes of resuscitated cardiac arrest due to TrP (Figure 1), manifested as seizures and syncope described by the patient and its' family as no different as the other previous grand mal epileptic attacks.

The patient mentioned that the current episodes (2 days before admission) occurred during daily activity combined with high emotional state and was preceded by palpitations. She reported no personal history of cardiovascular disease or risk factors, but family history revealed SCD in her older sister at the age of 15.

To note, the previous anti-epileptic treatment failed to control the periodical attacks.

The clinical evaluation upon admission described normal cardiovascular, respiratory and central nervous system examinations and no detectable heart or vascular bruits. Blood pressure was 100/60 mmHg and the heart rate was 98 beats/min. The chest X-ray and laboratory findings ranged within normal limits. An ECG tracing revealed prolonged QT and corrected QT (QTc) interval (Figure 2).

Transthoracic echocardiography identified no cardiac structural abnormalities (including cardiac congenital anomalies),

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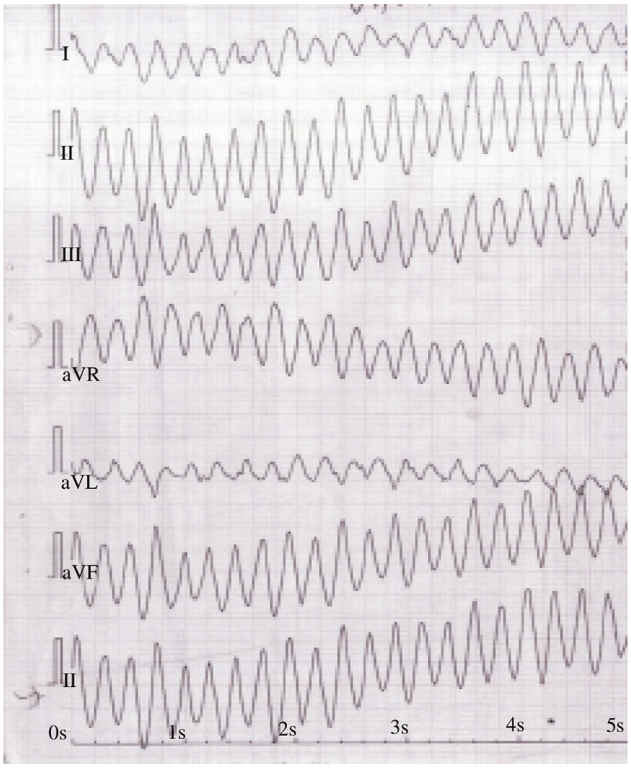

Figure 1. Episodes of TrP before admission.

normal ventricular function and absence of hemodynamically significant valvulopathies.

ECG traces were obtained in all immediate family members. Prolonged QTc was identified in the patient's mother (Figure 3), while the father and brother presented a normal ECG pattern.

3. In-hospital course

In an attempt to minimize the possibility of long QT iatrogenic potentiating, both anti-epileptic drugs (valproate and levetiracetam) were considered for their effects upon cardiac repolarization, though no robust evidence-base data support association between these drugs and QT prolongation.

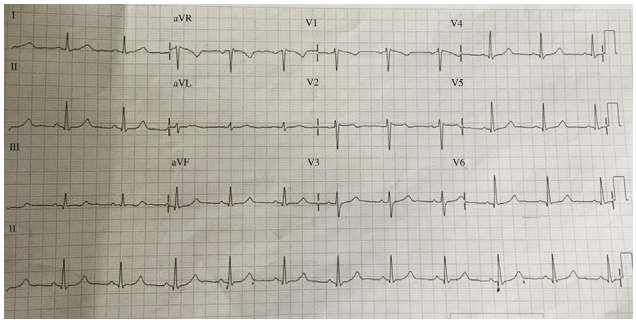

Figure 3. The ECG from patient's mother (QTc prolongation of 484 ms and incomplete right bundle block).

The patient reported very few symptoms during hospitalization including intermittent thoracic pain during emotional stress and anxiety. Concomitant ECG tracing described no particular ischemic changes but a rather different LQTS pattern was shown above (Figure 4).

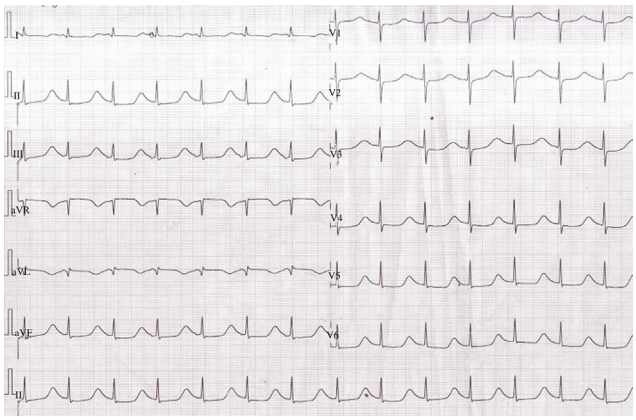

Figure 4. ECG trace during thoracic pain (long QT interval and asymmetrically peaked T wave).

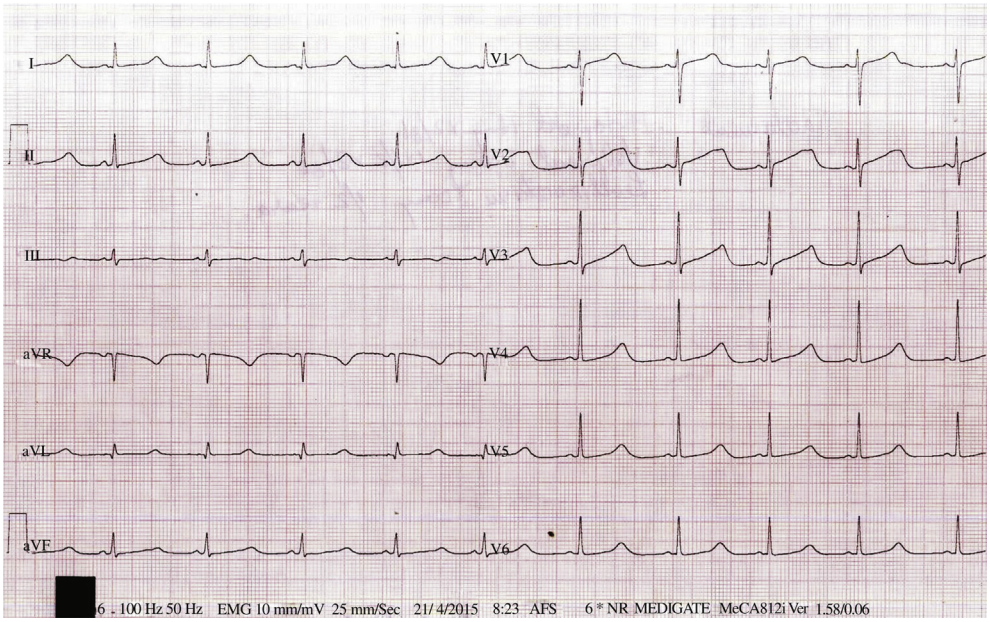

Figure 2. ECG upon admission.
Normal sinus rhythm, prolonged QT interval and a T-U complex as well as broad-based T wave were described. The rate-corrected QT interval (QTc) was 612 ms using the Bazett correction.

Unicameral implantable cardioverter defibrillator (ICD) was implanted without any notable per-procedural complications.

One month after discharge, the patient's ECG was ambulatory monitored for 24 h and revealed an average ventricular rate of 70 beats/min (under beta-blocker and valproate treatment). The ICD interrogation revealed no specific dysrhythmias. ICD monitoring and close clinical follow-up of the patient were recommended at 3, 6 and 12 months.

4. Discussion

The above presented case offers the specific clinical spectrum of manifestations: symptoms' onset at the age of 4 (seizures and syncope that spontaneously remitted in the past), unrecognized ECG changes, unsuccessfully treated epilepsy with repeated cardiac arrest due to TrP and ventricular fibrillation preceded by palpitations. Unicameral ICD was subsequently implanted in order to reduce future cardiovascular risk.

Congenital LQTS is a familial inherited disorder with specifically variable penetration (mainly autosomal dominant while recessive forms are not uncommon) caused by gene mutations that encode sodium, calcium and potassium cardiac channels[1].

Over the last years, the effort to understand the underlying genetic mechanisms of cardiac action potential disturbances leading to these fatal repolarization disorders offered a new perspective upon diagnostic, risk stratification, treatment options and family screening directed to reduce the commonly associated cardiac death.

Long QT 1 (LQT1) is known to be caused by the mutations of genes encoding the slow component of the potassium current. Still, when it comes to epilepsy associated with LQTS 1, the molecular mechanisms remain unclear. Sudden unexplained death in epilepsy is a recognized event among patients with epilepsy (17% prevalence)[2]. In addition, KCNQ1 expression (a component of potassium current channels) in forebrain neuronal networks and brainstem nuclei (regions in which anomalies of neurons repolarization after an action potential can produce seizures and dysrhythmias) was demonstrated. These recent findings underline the dual arrhythmogenic potential of an ion channelopathy co-expressed in the heart and brain and a possible relationship between epilepsy and LQT1[3].

It is confirmed by literature reports that the ST-T segment's morphology has been successfully used in predicting the specific genotype of LQTS, a feature particularly important for the subsequent genetic analysis in the majority of cases[4,5]. This information is clearly important considering that extensive genetic testing is not possible in LQTS patients (15 distinct LQTS-susceptibility genes and hundreds of gene' mutations described so far)[6]. Targeted genetic testing after clinically suspecting a certain genotype seems to be a more appropriate strategy. Up to 80% of the LQTS cases are correctly identified based on ECG findings[4].

Genetic testing has been largely used as it may increase diagnostic sensitivity and increase diagnostic accuracy in borderline cases[1]. However, a subsequent negative genetic test in these patients does not exclude LQTS[7]. When the genetic approach is not available, ECG remains the most useful, cheap and highly available diagnostic tool in LQTS.

In this case, we firstly assessed the ECG patterns in order to establish the type of LQTS. Generally, LQTS type 1 is defined by broad-based, peaked/asymmetrical T wave particularly in precordial leads, but normal or late-onset normal T wave are not uncommon. The mainly described pattern in LQTS 2 is of bifid/low amplitude T wave, while late-onset peaked or asymmetrical peaked T wave is the hallmark for LQTS 3[4]. Noteworthy, we encountered both LQTS 1 and 3 patterns in our case as presented.

As the ECG patterns could resemble the two types of LQTS, the clinical presentation in such cases should be considered as the conditions that trigger most of the cardiac events which are gene-specific, suggesting that life-threatening dysrhythmias may occur under specific circumstances. Recent studies demonstrated that exercise was the specific triggering in 62% of LQTS 1, significantly contrasting with 13% in LQTS 2 and LQTS 3[8]. Also, the appearance of lethal cardiac events while exercising was present in 68% of the cases in LQTS 1 when compared to 4% in LQTS 3 patients, which showed a rather high prevalence of lethal events during sleep and rest (39%). Additionally, LQT1 patients tend to develop symptoms earlier than LQT2 and LQT3, almost 54% of them being symptomatic before the age of 10[8].

Based on clinical presentation, familial history and ECG abnormalities, current diagnosis of type 1 LQTS was established and beta-blocker therapy was immediately considered.

One of the strongest predictors in assessing future life-threatening cardiac events in LQTS patient is the history of syncope (frequency and timing). More than 2 episodes during the last 2 years (age between 10 and 20) include the patient in the high-risk category, future potentially deadly cardiac events (18-fold increased risk by comparison to those without episodes)[9]. Moreover, a history of aborted cardiac arrest and ECG-documented episodes of TrP sustain the high-risk category based on the published mortality rates in the field[10].

The decision for ICD in the presented case was based on a clear history of life-threatening cardiac arrhythmias, frequent syncope, history of previous familial SCD and established diagnosis of congenital LQTS.

Due to the high clinical resemblance, general epilepsy could mask SCD in young patients with previously undiagnosed congenital LQTS. The presented case emphasized the need to correctly diagnose this disease otherwise treatable, lethal condition.

It was also highlighted the importance of a multidisciplinary team (pediatric, neurologist, cardiologist) in assessing young patients presenting syncope and seizures.

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Conflict of interest statement

The authors report no conflict of interest.

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References

[1] Lu JT, Kass RS. Recent progress in congenital long QT syndrome. *Curr Opin Cardiol* 2010; **25**(3): 216-21.

[2] Scorza FA, Cysneiros RM, de Albuquerque M, Scattolini M, Arida RM. Sudden unexpected death in epilepsy: an important concern. *Clin (Sao Paulo)* 2011; **66 Suppl 1**: 65-9.

[3] Goldman AM, Glasscock E, Yoo J, Chen TT, Klassen TL, Noebels JL. Arrhythmia in heart and brain: KCNQ1 mutations link epilepsy and sudden unexplained death. *Sci Transl Med* 2009; **1**(2): 2ra6.
[4] Zhang L, Timothy KW, Vincent GM, Lehmann MH, Fox J, Giuli LC, et al. Spectrum of ST-T-wave patterns and repolarization parameters in congenital long-QT syndrome: ECG findings identify genotypes. *Circulation* 2000; **102**(23): 2849-55.
[5] Kaufman ES, Priori SG, Napolitano C, Schwartz PJ, Iyengar S, Elston RC, et al. Electrocardiographic prediction of abnormal genotype in congenital long QT syndrome: experience in 101 related family members. *J Cardiovasc Electrophysiol* 2001; **12**(4): 455-61.
[6] Giudicessi JR, Ackerman MJ. Genotype- and phenotype-guided management of congenital long QT syndrome. *Curr Probl Cardiol* 2013; **38**(10): 417-55.
[7] Tester DJ, Ackerman MJ. Genetic testing for potentially lethal, highly treatable inherited cardiomyopathies/channelopathies in clinical practice. *Circulation* 2011; **123**(9): 1021-37.
[8] Schwartz PJ, Priori SG, Spazzolini C, Moss AJ, Vincent GM, Napolitano C, et al. Genotype-phenotype correlation in the long-QT syndrome: gene-specific triggers for life-threatening arrhythmias. *Circulation* 2001; **103**(1): 89-95.
[9] Moss AJ, Zareba W, Hall WJ, Schwartz PJ, Crampton RS, Benhorin J, et al. Effectiveness and limitations of beta-blocker therapy in congenital long-QT syndrome. *Circulation* 2000; **101**(6): 616-23.
[10] Moss AJ, Goldenberg I. Importance of knowing the genotype and the specific mutation when managing patients with long QT syndrome. *Circ Arrhythm Electrophysiol* 2008; **1**(3): 213-26.