

Stress exercise test inducing ventricular arrhythmias in LQT interval individuals

Abstract

From the records of a main public Hospital in Jamaica we selected a group of 90 patients who descend from a Caribbean Afro-American origin, age was between 40 and 60 years and apparently healthy individuals who went on the treadmill stress test for exclusion of Ischemic Heart Disease, the cause of Syncope and Arrhythmia investigation. From this group we picked up those who showed exercise induced ventricular arrhythmias and we studied the prevalence of Long QT interval in these patients and the relation to stress test. The aim of the study was to prove not only the relation between stress of exercise and induction of ventricular arrhythmias but also the relation of this induced arrhythmia and the presence of Long QT interval and eventually to attract the attention of the Clinicians who are performing stress tests and finding multiple ECG leads with ventricular complexes to proceed and start looking for the presence of Long QT intervals present especially with a history of exercise induced syncopal attacks or family history of premature deaths. This will assist the physicians in taking rapid action to start preventive therapeutic measurements to demolish the expected sudden cardiac arrest that may develop in these patients, especially when they perform a strenuous exercise or other predisposing situations during their life time.

Keywords: stress test, arrhythmia, lqt interval, scd, syncope, premature death

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Method

We selected from the available records 90 relatively young, apparently healthy patients, who had performed a planned stress test (treadmill stress test) and we reviewed the ECG results to find how many of them had induced frequent ventricular premature waves or showed syncopal or syncopal like attacks. The age group was between 40 and 60 years, females were accounting the majority of patients and all patients were from Afro-American origin. All patients with secondary causes of prolonged QT interval were excluded (history records), we have excluded individuals with rest ventricular premature beats and those who smoke cigarettes and consume alcohol more frequently. We have defined the term “frequent ventricular beats” as: they exceed the median of 1 ventricular beats per 5.0 minutes of exercise. We were lucky to acquire the ECGs of the pre-exercise, during exercise and 6-10 minutes post-exercise periods. The measurements of the QT intervals were taken directly from the ECG machines and confirmed manually using the Bazett formula, taking the longest ECG serials, the longest value, from lead II, V5 and V6, and starting from QRS complex Q wave till the end of the T wave when it goes to base line. The calculated definition of Corrected prolonged QTc interval was: > 450 ms in males and > 460 ms in females.¹⁻⁵

Results

Out of the 90 patients who performed the treadmill exercise test and showed satisfactory test results (reached the 85% of estimated heart rate related to age), 46 patients (51% of total) had multi-lead ventricular complexes, and out of those 32 patients (69 % of positive finding) had Long QTc intervals and 20 patients out of them (43% of positive finding) had associated history of syncope or syncope like symptoms. Only 2 patients out of them (4% of positive finding) had a history of pre-mature SCD in the first degree relatives. Interestingly 31 patients (97% of positive finding) with Long QTc interval were females and only 1 (3% of positive finding) was a male. The range of the QTc interval was between 470 ms and 500 ms and all of them were with wide based “T” wave giving a probable clue to the

presence of LQT 1 which is usually triggered by strenuous exercise. Only 3 female patients (6.5% of positive finding) had expressed a post exercise ventricular premature beats. None of the patients showed any Syncopal or Syncopal like symptoms during or after exercise.

Acquired causes of LQT interval

There is a large list of medications that can induce prolongation of QT interval, some examples are: Adrenaline (local anesthesia, control of severe asthma), some Antihistamines (like Hismanal, Benadryl and Seldane), some Antibiotics (Erythromycine, Seprin, Pentamidine) Heart medications such as (Quinidine, Procainamide, Disopyramide, Sotalol, Ibutilide), Anti fungals (Ketoconazol, Fluconazol), Psychotropic drugs (Tri cyclic antidepressants, Phenothiazine derivatives, Haloperidol), Potassium loss medications Indapomide, anti emetics and anti diarrheas). Other predisposing factors are also important like: Female gender, Hypokalemia, Bradycardia, recent conversion of AF, Cardiac de-compensation and Hypothermia. All the above were excluded from the study.

The long qt interval and ventricular arrhythmias

The presence of the LQT interval is interesting to clinicians due to its danger of creating sudden death through precipitating the Torsades. These Torsades will range from minor symptoms such as dizziness and extending to more serious events of seizure, syncope and sudden death. The congenital LQT usually manifests before the age of 40 years, mainly obvious in childhood and adolescence. Men are less liable to the development of cardiac events because of shorter QT intervals compared with women, boys and girls, especially in LQT2 and LQT3 groups. The risk of sudden death due to Torsades is highest at the early waking hours (especially morning waking hours), which correlates with the diurnal physiological peak of the QT interval at that time. The patients with QT interval of > 440 ms are at 2 to 3 fold increase risk for sudden death than those with QT interval < 440 Ms. The mortality rate in untreated patients with LQT is in the

range of 1% to 2% per year. The frequency of cardiac events were significantly higher among subjects with congenital LQT1 (63%) and LQT2 (46%) than among subjects with LQT3 (18%). It is obvious from different studies that Sudden death phenomenon in patients with LQT intervals is often initiated by a triggering event, such as heavy physical exercise, sports like swimming, sleep deprivation and anger. These events tend to aggregate in families as a function of the genotype. Strenuous physical exercise is more prone to participate cardiac events in patients with LQT1, auditory stimuli in patients with LQT2, and rest and sleep in patients with LQT3. The high risk factors of sudden death in patients with LQT include recurrent episodes of syncope, failure of medical therapy, survival from cardiac arrest, congenital deafness, female sex, QTc interval of > 600 ms, relative bradycardia, and sudden cardiac death in a family first degree member at an early age.⁶⁻¹⁰

Discussion

It is a clear concept to all clinicians that strenuous exercise may induces ventricular arrhythmias, but it is not clear of the interesting clinical combined observation of effect of the strenuous effort (exampled here by exercise stress test) and the induction of the ventricular complexes in the presence of prolonged QT intervals and how this will allow the physician to detect the correlation and act accordingly to prevent the lethal future event that may take place due to this combination. The important studies done previously did not mention the correlation of the stress test inducing ventricular Arrhythmias in the existing of the prolonged QT interval directly and if this is a cause of end point mortality in those patients. This was evident in the studies done by Morshedi-Meibodi et al, Baltimore Longitudinal Study, Mora et al and Jouven et al and others that are published in different issues of the Cardiology Journal. This study proves clearly the induction of ventricular arrhythmias by the presence of LQT interval with a mediator which is a strenuous exercise. In the 2014 ECG criteria proposed for Athletes screening (Seattle criteria), the presence of LQT interval is one of the criteria to have possible risk of developing sudden death. Also the Seattle criteria indirectly support our study by giving the information that Ventricular pre-mature beats with 2 or more ventricular beats per 10 second tracing are a possible cause of sudden death (1.5 fold increase). The induction of ventricular ectopic rhythm with the presence of LQT interval is known risk factors for the development of Stroke (more that 1.5 fold increase risk compared with individuals who do not have these abnormalities).

The QT prolongation is associated with a two to four fold increase in death including Torsades and sudden death. All this should alert the attendant clinician to this important phenomenon and he or she can actively save the future life of these susceptible individuals ranging from changing of life style to medications and may pass through implantation of ICD. We will not forget here that Women are mostly affected putting more burdens on females as individuals with whole life risk to cardiovascular diseases compared to men.

Final short comments

This is a small retrospective study done in a particular Caribbean community where there is a high incidence of LQT interval between the local inhabitants of Jamaica without enough information supported by studies about this phenomenon. We have noticed the occurrence of frequent ventricular arrhythmias during exercise stress tests in young Athletes, and Jamaica has a large sum of them, and decided to perform this study to correlate between the high prevalence of LQT intervals among the population and the strenuous exercise usually performed by Jamaican young generation. The patient's data were collected from a Jamaican main public Hospital near Ocho Rios, the northern city of Jamaica, and it showed high tendency in the relatively young individuals performing exercise stress test to produce simple and complex ventricular extra systoles, the latter were more prevalent in those with LQT intervals and more in women than in men. Those individuals with ventricular premature beats due to LQT intervals are facing expected dangerous consequences in their future to develop cardiac arrests, in particular those who are professional athletes or on chronic strenuous sport practice. Unfortunately there were no available facilities in Jamaica to perform Genetic studies and to give us some valuable information regarding the genotype of each Long QT interval recorded, which could assist much in prevention and management of this interesting phenomenon. More extensive and wide studies involving different race and ethnic groups are needed to support our small study.¹⁰⁻¹⁵

Conclusion

Strenuous exercise can induce ventricular complexes in patients with prolonged QT intervals (and the latter were the cause of induction of the ventricular complexes) and physicians should be alert to this phenomenon taking place during the stress tests and should pick these patients at that time for further preventive management (Table 1).

Table 1 Table of results

Information aata	Number and information
Total number of patients involved	90 adults referred for different needs to perform exercise stress test.
Patients with ventricular complexes	46 adults, in multi-lead ECG
Patients with long QT/QTc	32 adults with ventricular complexes.
Patients with history of family premature SCD.	2 adults (both Females), in first degree relatives.
Patients with post exercise ventricular beats.	3 females.
History of syncopal spells	20 of the total adults had positive history of definite syncope and the rest with syncopal like history.
History of torsades des pointes	Could not be detected.
Total males	1 adult (out of the 32 positive for long QTc interval).
Total females	31 adults (out of the 32 positive for long QTc interval)
Age group	The age group was between 40-60 years of age.
Race	All patients were coming from Afro-American origin living in the Caribbean region.

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Our study did not show any obvious conflict of interest. Kingston, Jamaica, West Indies 2014.

Conflicts of interest

The authors declare no conflicts of interest.

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