Patient Resources: Cardiac Channelopathies

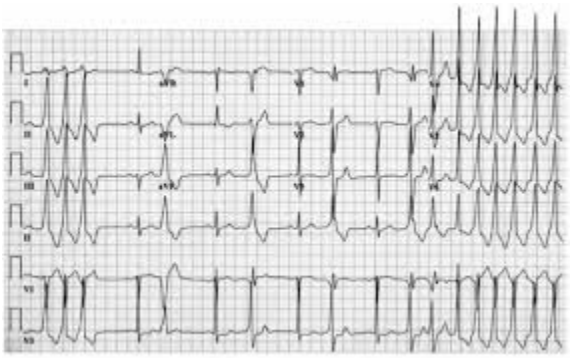
Overview of Cardiac Channelopathies: CPVT, Long QT Syndrome and Brugada Syndrome

Heart muscle cells contract because of movement of certain molecules (called “ions”) across the walls (called “membranes”) of the cells. The three most important ions are calcium, sodium, and potassium. The membrane of each heart cell controls the movement of these ions into and out of the cell by using specials “channels.” In cardiac channelopathies, these channels do not work like they are supposed to, letting too much (or too little) of a certain ion through. Channelopathies increase a child’s risk for life-threatening heart rhythms and for sudden cardiac death (SCD). Examples of channelopathies include Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT), Long QT Syndrome (LQTS), and Brugada Syndrome (BrS). **It is important to remember that while channelopathies are serious medical conditions, they are frequently treatable when they are detected and properly diagnosed.**

Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)

CPVT is an abnormal heart rhythm (arrhythmia) caused by the body’s “fight or flight” response that happens in times of stress or physical exercise/exertion. At these times, the body releases hormones called “catecholamines”, more commonly known as adrenaline, noradrenaline, and dopamine.

In most patients with CPVT, the release of catecholamines, such as with physical exertion during competitive sports, causes an abnormal release of calcium by the heart’s cells and can lead to an irregular fast rhythm in the ventricles (bottom chambers of the heart), called polymorphic ventricular tachycardia. This rhythm can result in low blood flow out to the body, including to the heart tissue itself, which can then lead to syncope (fainting) or even sudden death. Patients with CPVT can also have irregular heart rhythms in the atria (the top chambers of the heart). The resting electrocardiogram (ECG) (also commonly called EKG) in a person with CPVT is often normal. Signs of this disease are usually only visible with stress or physical activity when there is an increase in catecholamines.



People with CPVT often have episodes of fast heart rates (ventricular tachycardia) that might be combined with periods of normal heart rates. The longer and faster the ventricular tachycardia, the more dangerous the episode.

Symptoms

Symptoms of CPVT include dizziness, palpitations (fast, or “skipped heart beats”), syncope (fainting), or even sudden death associated with exercise or extreme stress/emotion in patients with structurally normal hearts and normal resting ECGs. Sometimes, these episodes may be diagnosed as exercise-induced loss of consciousness or seizures until a cardiac evaluation is performed and the true cause identified.

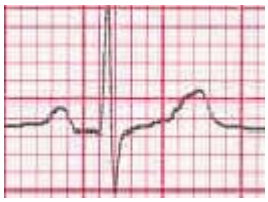
Diagnosis

Exercise testing may help confirm a CPVT diagnosis, but a normal exercise test does not mean that a child does not have CPVT.

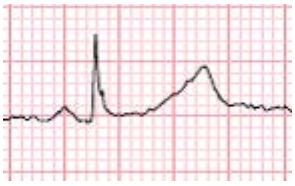
Genetic testing-please see Genetic Testing section at the end of this document.

Long QT Syndrome (LQTS)

Long QT syndrome (LQTS) is a condition that affects the flow of ions into and out of the cells in the heart. This abnormal flow of ions can prolong the patient’s QT interval, which is measured on an ECG. The prolonged QT interval affects how electrical impulses travel through the heart. Electrical activity may be transmitted abnormally through the lower heart chambers (ventricles) leading to potentially life-threatening ventricular arrhythmias. LQT syndrome is usually, but not always, inherited.



Normal QT interval



Prolonged QT interval

Symptoms

Symptoms of LQTS include dizziness, palpitations, fainting, or, sudden death. Again, patients may be diagnosed with seizures or drop spells, especially following sudden startles, such as fire alarms. These symptoms can also be triggered by stress or physical activity, particularly swimming. Patients with LQTS frequently have an abnormality on a resting ECG.

Diagnosis

Screening for LQTS includes measuring the QT interval on a resting ECG, but may also be measured during or after exercise to check for QT prolongation with physical activity.

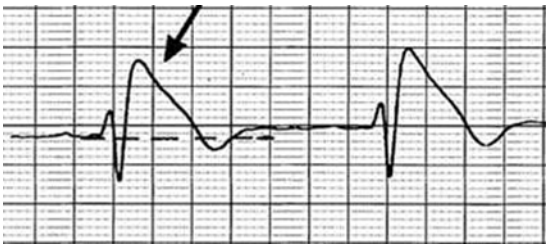
Genetic testing-please see Genetic Testing section at the end of this document

Patients with LQTS should avoid certain medications that can prolong the QT interval. A list of drugs to avoid can be found at www.crediblemeds.org.

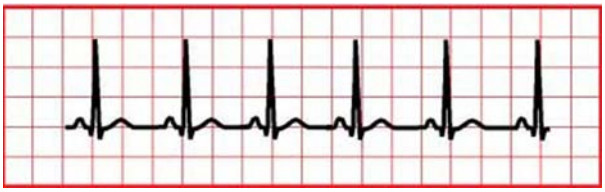
Brugada Syndrome (BrS)

Brugada syndrome is a channelopathy that can also cause dangerous ventricular arrhythmias. Patients with BrS can have an abnormal pattern on their ECG. Brugada syndrome is the rarest of the channelopathies and usually presents when a person is in their 30's to 40's. However, itis often identified when family members of patient with BrS are being tested, or when someone is having an ECG for a non-cardiac reason, such as a sports physical. There is no treatment that completely prevents episodes of ventricular arrhythmias, but medications affecting sodium channels in the heart may be used.

Brugada pattern



Normal ECG



Symptoms

Symptoms of BrS may include dizziness, fainting, sudden death, or no symptoms at all. Development of a fever appears to trigger BrS events, so aggressive treatment of fever in addition to close monitoring, is warranted for all BrS patients regardless of their symptoms or the presence of an implantable cardioverter defibrillator (ICD).

Diagnosis

In addition to the ECG findings, an IV medication can be given while the patient is being monitored to help aid with the diagnosis. This procedure is called a medication challenge.

Genetic testing-please see Genetic Testing section at the end of this document

As with LQTS, patients with BrS should avoid medications known or suspected to provoke BrS events whenever possible. A list of drugs to avoid can be found at www.brugadadrugs.org.

Treatment of Channelopathies

Treatment of channelopathies focuses on preventing and treating ventricular arrhythmias. Your cardiologist may prescribe medications which lessen the effect of catecholamines in our bodies, or which affect the ion channels of the heart cells, or other types of medications used to treat abnormal heart rhythms. Patients may be restricted from competitive sports, and some may require even stricter limitations. Implantation of an implantable cardioverter defibrillator (ICD or defibrillator) (see ICD/pacemaker overview) may be indicated for certain patients, especially those who have had a life-threatening arrhythmia (such as ventricular tachycardia or ventricular fibrillation). Depending on the diagnosis, and the severity and frequency of a patient's episodes, a surgery to cut the nerve that makes the heart respond to catecholamines may be offered (denervation procedure). This surgery may take place before or after ICD implantation. Even after ICD implantation, patients may be required to continue with their medications and activity restrictions.

Restrictions

Activity restrictions are determined by the specific channelopathy that is present, and the presence or absence of an ICD. Your healthcare team will help guide you in the decision-

making process. Even if there are some restrictions, it will be important to discuss the activities that are safe and appropriate for the patient, and to focus on what CAN be done!

Genetic Testing and Channelopathies

For information about genetic testing in patients with arrhythmias, please visit our Basic Electrophysiology Page. Genetic testing and genetic counseling can be valuable tools when evaluating patients, and their family members, for channelopathies. The genetic changes that cause some channelopathies may even guide your cardiologist or electrophysiologist (cardiologist who specializes in heart rhythm conditions) to choose one specific medication. If a known disease-causing genetic mutation (change in the gene's sequence or pattern) is found in a patient, it can help direct future testing in other family members to determine their risk of developing the disease.

While genetic testing is valuable in both diagnosis and prognosis, it has limitations as well. Sometimes, a genetic change may be found that has not been shown to be disease-causing, but also has not been found to be harmless. In addition, a genetic defect may be present but it is not able to be detected with current testing. Genetic testing is expensive, especially during the initial evaluation, because many genes may need to be tested. These costs may or may not be covered by a patient's medical insurance. Finally, testing may take weeks to months to complete, and this waiting period can be very stressful for patients and their families.

The decision about whether or not to do genetic testing is best made after thoughtful discussion with your healthcare team.