

The QT interval: How long is too long?

By Natalie K. Cox, RN
Staff Nurse • Coronary Care Unit • McLeod Regional Medical Center • Florence, S.C.

What's the QT interval and why's it so important? In this article, I'll answer these questions plus show you how to measure the QT interval and how to recognize the types of long QT syndrome (LQTS) and their symptoms, causes, and treatments.

The long and short of it

The QT interval on the ECG is measured from the beginning of the QRS complex to the end of the T wave (see *ECG components*). It represents the time it takes for the ventricles of the heart to depolarize and repolarize, or to contract and relax.

The QT interval is longer when the heart rate is slower and shorter when the heart rate is faster. So it's necessary to calculate the corrected QT interval (QTc) using the Bazett formula: QT interval divided by the square root of the R-R interval. The R-R interval is measured from one R wave to the next R wave that comes before the QT interval being measured. For example, if the QT interval measures 0.44 second and the R-R interval measures 0.86 second, then the QTc is 0.47.

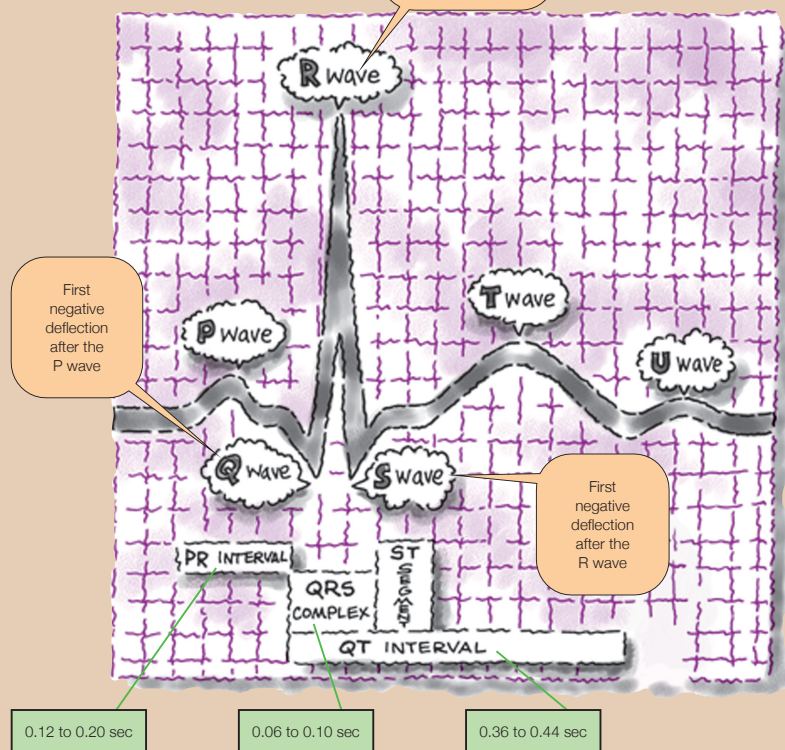
The normal QT interval varies depending on age and gender, but it's usually 0.36 to 0.44 second (see *QT interval ranges*). Anything greater than or equal to 0.50 second is considered dangerous for any age or gender; notify the healthcare provider immediately.

There are several factors that make it difficult to measure the QT interval. A wide QRS complex on an ECG may give

the appearance that the QT interval is prolonged. However, a wide QRS complex represents depolarization, and LQTS is a disorder of repolarization. Sometimes the end of a T wave isn't clearly defined, which can make it difficult to get the QT measurement. Irregular rhythms also make it difficult to obtain a consistent QT interval measurement. For example, atrial fibrillation makes it extremely difficult to measure a QT interval because finding a T wave isn't always

ECG components

ECG components



QT interval ranges

	Age 1 to 15	Adult man	Adult woman
Normal	Less than 0.44 second	Less than 0.43 second	Less than 0.45 second
Borderline	0.44 to 0.46 second	0.43 to 0.45 second	0.45 to 0.47 second
Prolonged	Greater than 0.46 second	Greater than 0.45 second	Greater than 0.47 second

Source: Jacobson C. Long and short of it: What's up with the QT interval? <http://hosted.mediasite.com/mediasite/Viewer/?peid=9ed8856fcdab4bc0bb066c25a148435b1d>.

possible with this rhythm. The best thing to do is measure five or six QT intervals and average them together.

Each lead of an ECG will most likely give you a slightly different QT measurement. When measuring QT intervals, it's important to find a lead on the ECG that has a T wave with a clearly defined end. Always use that lead when measuring your QT interval, and remember to be consistent with your measurement technique (see *Calculating QT interval duration*).

How did it get so long?

LQTS is a result of the heart's electrical system recharging abnormally. There are two types: acquired and congenital. Acquired LQTS is caused by an underlying medical condition, such as drugs that prolong the QT interval, electrolyte imbalances (such as caused by anorexia), and bradycardia. Congenital LQTS is inherited from one or both

parents. In addition, there are 12 different subtypes of LQTS, labeled LQT1 to LQT12.

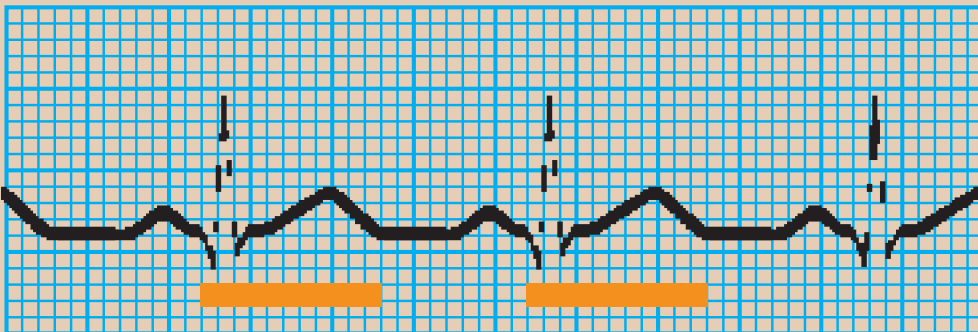
There are many drugs that can prolong the QT interval, such as some antibiotics, antidysrhythmics, antihistamines, antifungals, and antipsychotics. Other categories of drugs that cause QT prolongation are some heart medications, cholesterol-lowering drugs, and diabetes medications. This doesn't mean that all drugs in these categories can cause it, but many of them can. A person is more likely to develop QT prolongation from these drugs if they have the following risk factors: renal dysfunction, hypokalemia, hypomagnesaemia, bradycardia, advanced age, female gender, underlying heart disease, and polypharmacy. Be aware of these risk factors in your patients and be aware of the drugs they're on.

Whenever you start a patient on a new drug that may prolong the QT interval, always document the baseline QT interval before administering the drug. Continue monitoring and documenting the QT interval at least once every 8 hours. Talk to the healthcare provider about correcting any electrolyte imbalances, such as low potassium, magnesium, calcium, and sodium, before starting the drug. Keep the patient on a cardiac monitor and look for signs of impending torsades de pointes (TdP).

Congenital LQTS is a genetic mutation of the ion channels in the cardiac cells. It affects the flow of potassium and sodium in and out of the cells. Genetic testing is

Calculating QT interval duration

Count the number of squares from the beginning of the QRS complex to the end of the T wave. Multiply this number by 0.04 second. The normal range is 0.36 to 0.44 second, or 9 to 11 small squares wide.



used to determine whether a person has the congenital form. Three of the congenital types are more common than the others: LQT1, LQT2, and LQT3. People with congenital LQTS are prone to go into TdP when there's an external stimulus. The triggers for TdP are somewhat specific to the type of LQTS a person has (see *TdP triggers in congenital LQTS*).

Beta-blockers are the main medication used for the management of congenital LQTS. If medication isn't successful, then the patient may need dual chamber pacing at a rate to shorten the QT interval. For patients at increased risk or those who continue to experience severe life threatening cardiac events, an implantable cardioverter defibrillator is strongly recommended.

If you take care of a patient newly diagnosed with congenital LQTS, patient education needs to be a priority. Teach the patient

TdP triggers in congenital LQTS

- **LQTS1:** Emotional stress or exercise, especially swimming or diving
- **LQTS2:** Extreme emotions or surprises, such as harsh, sudden noises
- **LQTS3:** Slow heart rate while sleeping

Source: National Heart, Lung, and Blood Institute. What is long QT syndrome? http://www.nhlbi.nih.gov/health/dci/Diseases/qt/qt_all.html.

to prevent adrenergic surges in heart rhythm by avoiding loud noises, such as telephones, doorbells, and alarm clocks. The patient may need to turn down the doorbell and phone volume or turn the phone ringer off at night. Also teach the patient to avoid overexertion. Patients with confirmed LQTS1 or LQTS2 shouldn't participate in competitive sports. Tell the patient to seek medical attention



Nursing2011 Symposium®
The Conference for Clinical Excellence

April 28 – May 1, 2011
Gaylord Opryland
Resort & Convention Center
Nashville, Tennessee

For more information on topics, speakers, continuing education, submitting a poster presentation, registration fees, and more ...

Go to NursingSymposium.com
or call 1-800-346-7844, ext. 7798

Wolters Kluwer Health | Lippincott Williams & Wilkins
Publisher of *Nursing2011 Journal*

1Y016HZ

if he or she has any illnesses that lower the potassium levels, such as vomiting or diarrhea, because this could trigger an episode of TdP. Ask the patient whether he or she has any family history of sudden cardiac arrest.

With any patient in your care, always consider LQTS if the patient has fainted and it can't be explained by any other medical condition.

Getting to the point of torsades de pointes

What can happen if the QT interval is too long? If the QT interval lasts longer than 0.50 second (500 milliseconds), then a patient's heart rhythm is more likely to progress into TdP, an irregular chaotic heartbeat that's a type of polymorphic ventricular tachycardia (VT).

To determine whether a polymorphic VT is TdP, look at the beats around it. First the QT interval will be prolonged, usually with a pause in the heartbeat followed by a beat with a bizarre T wave. This is where TdP usually starts. When this happens, the cardiac output drops and the patient doesn't get enough oxygen to the brain and can faint. If the heart doesn't return to a normal sinus rhythm, it will eventually go into ventricular fibrillation. This is where the ventricles of the heart are quivering. Ventricular fibrillation requires immediate defibrillation because it can lead to sudden cardiac arrest if left untreated.

There are some signs of impending TdP that you need to be aware of:

- QTc greater than 0.50 second after starting a QT-prolonging drug
- frequent premature ventricular contractions (PVCs) and couplets (2 PVCs back to back) seen while monitoring the heart rhythm
- height of the T wave alternates from beat to beat (this may or may not occur)
- nonsustained runs of TdP after a pause.

When a patient is in TdP, always look at him or her and listen. Remember to ask the right questions. Ask the patient whether he or she has any chest pain or shortness of breath. Look to see whether there's a change in level of consciousness or BP. Print a rhythm strip and place it in the chart.

Review the patient's drug list and stop any medications that prolong the QT interval. Obtain lab work to check electrolyte levels, specifically potassium, sodium, magnesium, and calcium. Notify the healthcare provider immediately.

There are various ways to manage TdP. Give I.V. magnesium per the healthcare provider's orders. The healthcare provider may start the patient on a beta-blocker to shorten the QT interval. Digoxin can also shorten the QT interval. If the patient is still in TdP after this, overdrive pacing will be needed. A transvenous pacemaker is inserted and set at a rate between 100 and 110 beats/minute. This high heart rate prevents pauses and shortens the QT interval. As mentioned before, a patient in sustained TdP may progress to ventricular fibrillation and needs to be defibrillated immediately.

Going long

Remember, the key to good nursing care is to look at and listen to your patients. How do they look? How do they feel? Are they acting different than what's normal for them? Listen to what they tell you. Your vital sign readings and cardiac monitors only give you part of the information you need to take care of your patient. Your patient gives you the rest. ■

Learn more about it

Cardiovascular Care Made Incredibly Visual! Philadelphia, PA: Lippincott Williams & Wilkins; 2007:83,85.

Jacobson C. Long and short of it: What's up with the QT interval? <http://hosted.mediasite.com/mediasite/Viewer/?peid=9ed8856fcdab4bc0bb066c25a148435b1d>.

Mayo Clinic. Long QT syndrome. <http://www.mayoclinic.com/health/long-qt-syndrome/DS00434/METHOD=print&DSECTION=all>.

National Guideline Clearinghouse. ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. A report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Develop Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death). <http://www.guideline.gov/content.aspx?id=9725&search=2006+acc+guidelines+lqts>.

National Heart, Lung, and Blood Institute. What is long QT syndrome? http://www.nhlbi.nih.gov/health/dci/Diseases/qt/qt_all.html.

Sovari AA, Kocheril AG, Baas AS, Wojciech Z. Long QT syndrome. <http://emedicine.medscape.com/article/157826-overview>.

DOI-10.1097/01.NME.0000394049.90368.13

Be aware
of signs of
impending TdP.

