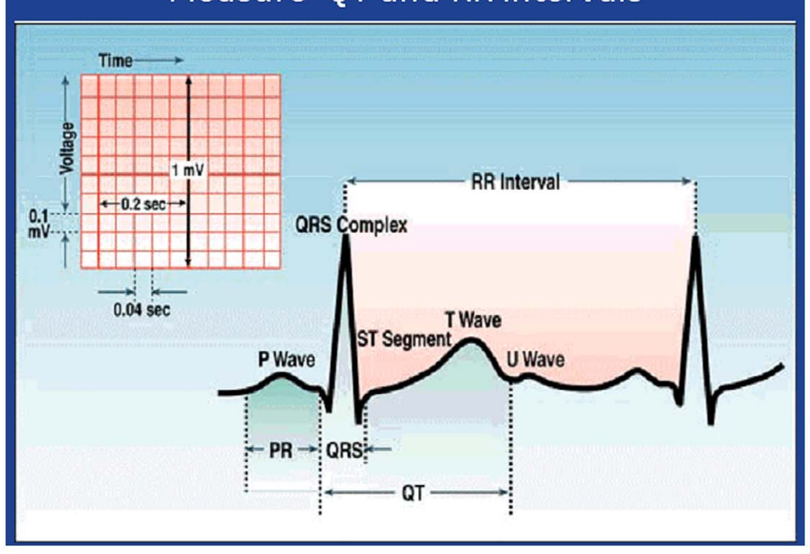
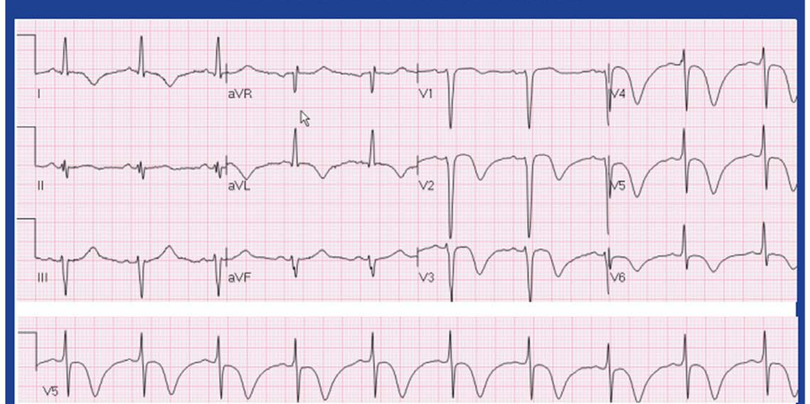
Recognition of Drug-Induced Proglonged QT

Measure QT and RR Intervals



Correct for Heart Rate

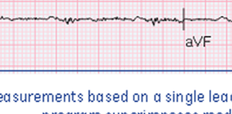


Correction Formulas

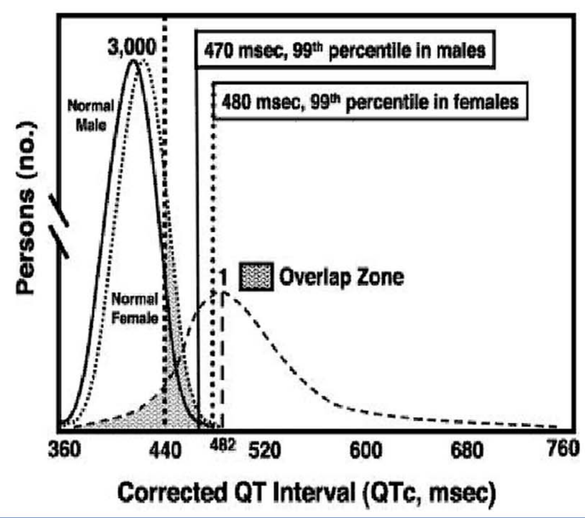
Bazett: $QTc = QT * (HR / 60)^{½}$

Fridericia: $QTc = QT * (HR / 60)^{1/3}$

Obvious Long QT: QT > ½ RR

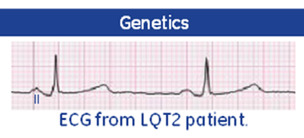


Check QTc versus Normal Limits



Risk Factors

Genetics

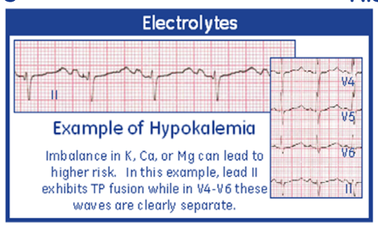


ECG from LQT2 patient.

"Current evidence suggests that 5 to 10 percent of persons in whom torsade de pointes develops on exposure to QT-interval-prolonging drugs harbor mutations associated with the long-QT syndrome." (Roden, NEJM, 2004)

Risk Factors

Electrolytes

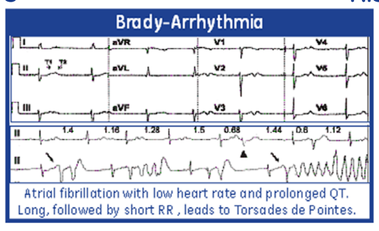


Example of Hypokalemia

Imbalance in K, Ca, or Mg can lead to higher risk. In this example, lead II exhibits TP fusion while in V4-V6 these waves are clearly separate.

Risk Factors

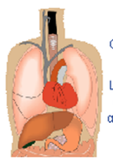
Brady-Arrhythmia



Atrial fibrillation with low heart rate and prolonged QT. Long, followed by short RR , leads to Torsades de Pointes.

Risk Factors

Poor Liver or Heart Function



Liver

Poor function can lead to toxic levels of prescribed drug.

Heart

Cardiac ischemia can prolong QT.

Low ejection fraction can increase risk of arrhythmic death due to prolonged QT.

Risk Factors

Drugs

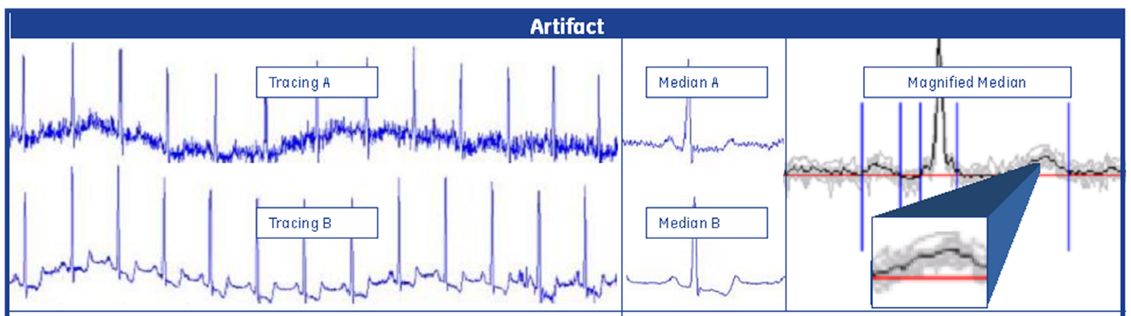
- Anti-depressants
- Anti-psychotics
- Anti-biotics
- Anti-arrhythmics
- Etc.

ARIZONA CERT

For more details check www.azcert.org

Tools and Strategies for Measuring Difficult ECGs

Artifact



Raw Rhythm Tracings

The artifact in tracing A is too excessive. The T-wave is not even visible. Advise repeat ECG. Tracing B exhibits a T-wave but the measurement of QT could be inconsistent due to baseline sway and muscle artifact. Select the best complex for measurement.

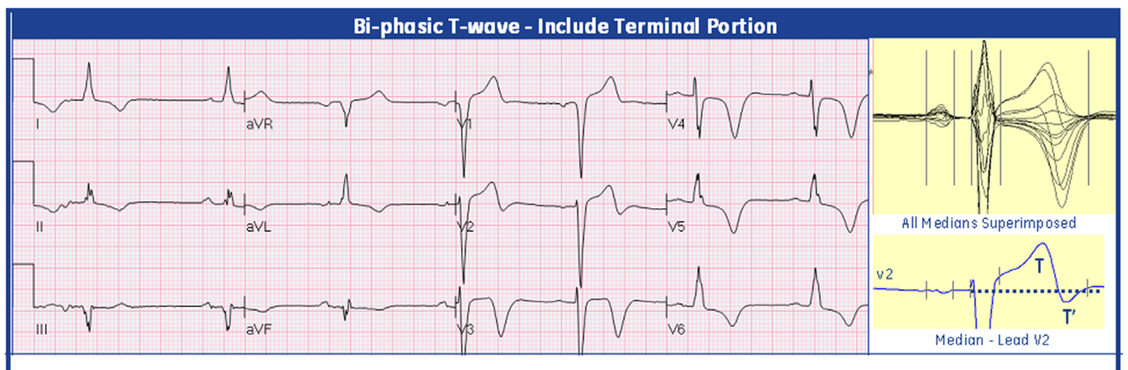
Median Complexes

A median complex is formed by taking the median value, at each sample time, from the superimposed raw beats. The result is a cleaner, represenatitive complex for measurement.

Flat T-wave in Limb Leads - Use All Leads

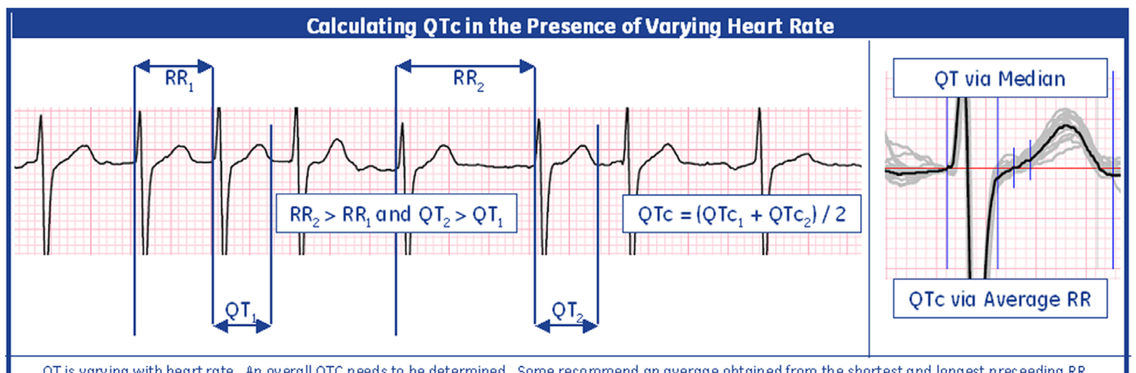
Measurements based on a single lead will result in error, especially if the lead has a flat T-wave. Check all leads. Use longest interval. GE's Marquette 12SL program superimposes median complexes from each lead. The automated QT measurement is from earliest QRS onset to latest T- offset.

Bi-phasic T-wave - Include Terminal Portion



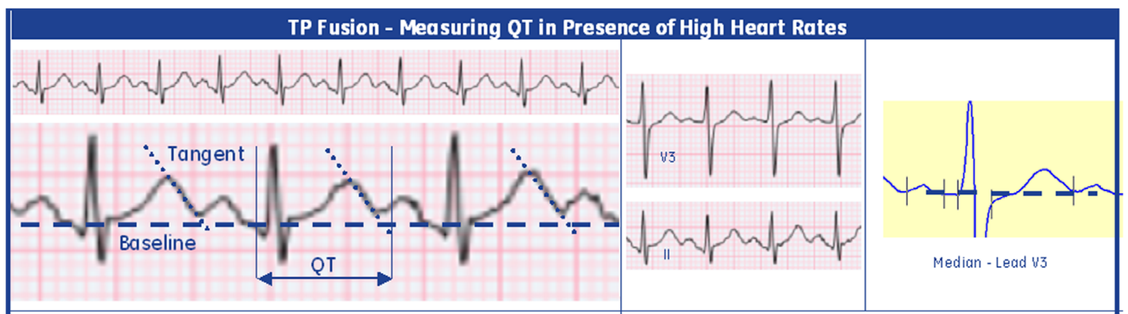
Do not define baseline based on the end of the T-wave. This can lead to the mistake of defining T offset within T'. QRS onset should define baseline. See V2. The entire wave of repolarization includes T and T'. Use all leads to assist in defining the end of repolarization.

Calculating QTc in the Presence of Varying Heart Rate



QT is varying with heart rate. An overall QTC needs to be determined. Some recommend an average obtained from the shortest and longest preceeding RR intervals. Others perform the avarage over 3 to 5 consecutive beats. Instead, GE's Marquette 12SL program uses QT from the median beat and the average RR.

TP Fusion - Measuring QT in Presence of High Heart Rates



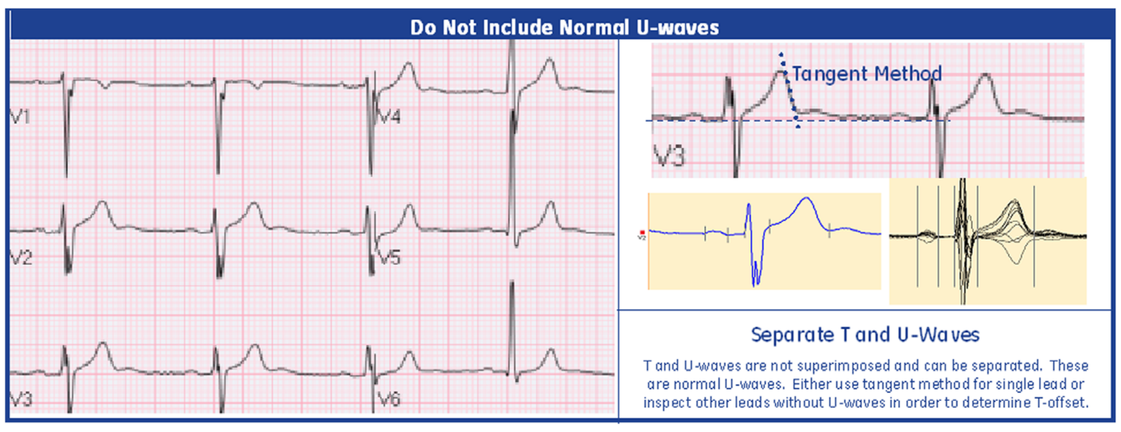
Single Lead: Use Tangent Method

At fast heart rates, the P-wave fuses with the T-wave, sometimes making it infeasible to measure the end of the T-wave. If possible, record and measure the QT at a lower heart rate. In a single lead, use tangent method to identify the end of the T-wave.

Inspect all 12 leads

In normal sinus rhyhm, leads V1 and II have the largest P waves. Other leads may reveal separation of P and T. Tic marks on 12SL medians report can be used to inspect 12SL measurements.

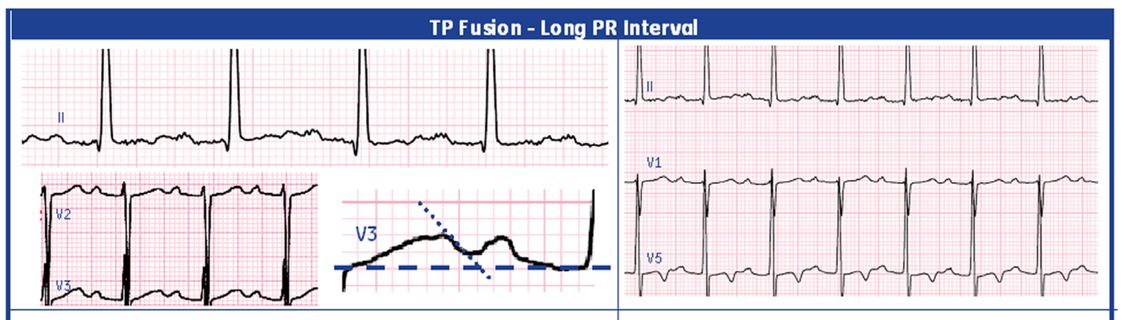
Do Not Include Normal U-waves



Separate T and U-Waves

T and U-waves are not superimposed and can be separated. These are normal U-waves. Either use tangent method for single lead or inspect other leads without U-waves in order to determine T-offset.

TP Fusion - Long PR Interval



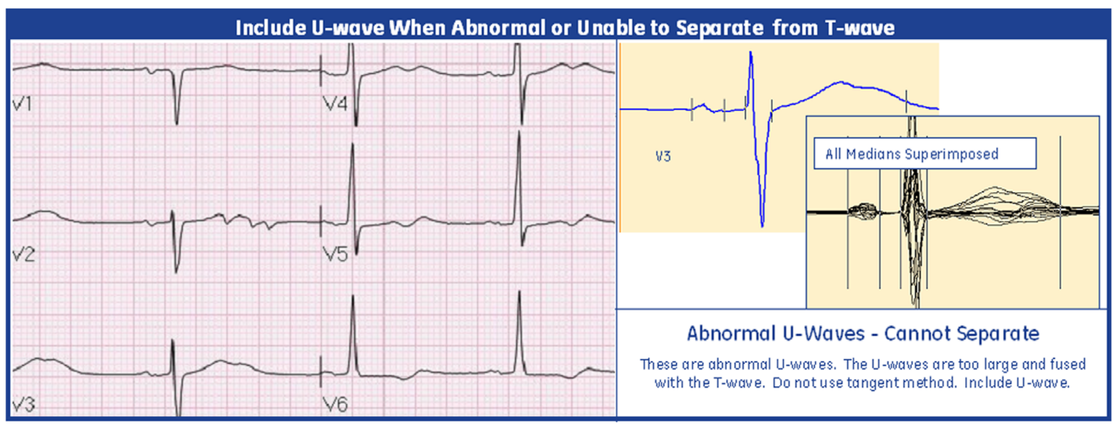
Tangent Method Limitations

Due to a long PR interval, the P wave is superimposed on the T-wave. In lead II, the T wave appears flat. The tangent method will be difficult to apply. In V3, the tangent method will result in a longer PR interval, than inspecting all the leads.

Inspect all 12 leads

By inspecting all leads, it is clear the T-wave shape is due to a long PR interval. In leads V1 and V5, the P and T-waves are separate.

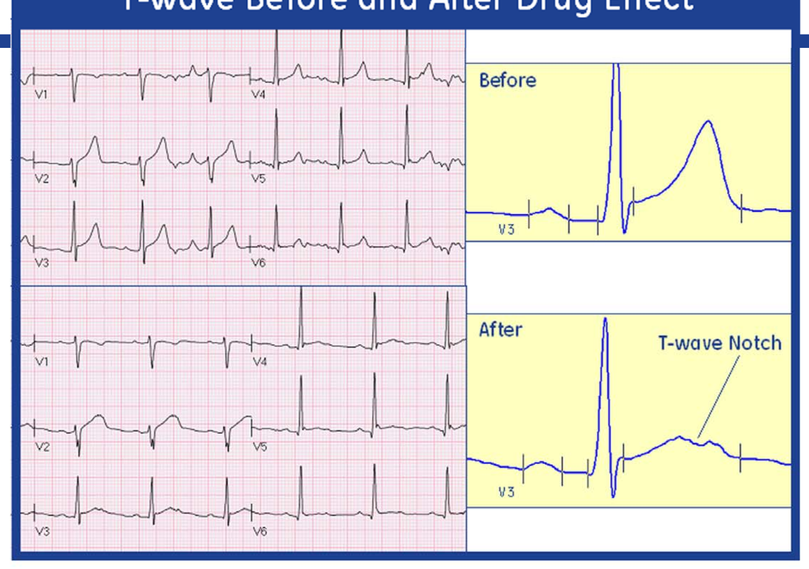
Include U-wave When Abnormal or Unable to Separate from T-wave



Abnormal U-Waves - Cannot Separate

These are abnormal U-waves. The U-waves are too large and fused with the T-wave. Do not use tangent method. Include U-wave.

T-wave Before and After Drug Effect



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