Abstract:

Background: The electrocardiogram (ECG) is typically an evaluation tool looked at based on its 2-dimensional configuration, including time duration and height at a particular point in of a wave of depolarization or repolarization. Thus far utilization of vectorcardiography (3-dimensional ECG, VCG) analysis for diagnostic and prognostic purposes has yielded improvement in information obtained from similar recordings as the 12-lead ECG. Certain measures such as the spatial QRS-T angle, even as derived from the 12-lead ECG using transform equations, have been useful in diagnosis of ischemic cardiomyopathies and for overall mortality prediction in various cardiomyopathies, ion-channelopathies and other disease states.

Aims/objectives: There are different applications for current derived vectorcardiographic measures, but there are still many diseases in which these measures can be applied for predictive and diagnostic purposes. Furthermore, particularly directed measures (in 3-dimensional space) may yield similar improved diagnostic and prognostic capabilities in particularly right or left sided diseases including arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C) and atrial fibrillation as well as in particular:

1. A novel P-wave vector magnitude and assessment for risk of atrial arrhythmia
2. Right-precordial directed vectorcardiography and its’ role in diagnosis of ARVC.
3. A protractor measured S-wave and its’ ability to identify ARVC without other ECG criteria.
4. Prognostic value of the Right-precordial-directed vectorcardiographic parameters in ARVC.
5. The ability of the T-wave vector magnitude to identify those electrographically concealed Long QT2 syndrome at risk for sudden cardiac death.

Methods: Derived vectorcardiography utilizing a well-proved regression method, the Kors’ regression-related method, as well as the Kors’ quasi-orthogonal method will be used to derive vectorcardiographic measures from 12-lead ECG’s to identify disease and those with particular diseases at risk for arrhythmia or sudden death. Derivation methods based on direct visualization of ECG’s and based on computational analyses including the Glasgow Algorithm will be utilized for derivation of these parameters. Also some more creative ECG measures based on a pathophysiology bases will also be utilized such as directing the VCG parameters right-ward and utilization of a protractor to measure an angle of the S-wave. Diseases will include those at risk for arrhythmias including ARVD/C, other non-ischemic cardiomyopathies, atrial fibrillation and long QT syndrome.

Results: Thus far improved identification of electrographically concealed ARVD/C utilizing right-precordial directed VCG as well as a protractor measured S-wave angle have been demonstrated. Prediction of symptoms in the same cohort of patients appears to be demonstrated by a right-precordial-directed spatial QRS-T angle. Development of cardiac events is predicted in electrographically concealed long QT2 patients by the T-wave vector magnitude. Prediction of atrial fibrillation in stroke patients appears to be related to the P-wave vector magnitude multiplied by Pwave duration.

Conclusion/Plan: Various applications of vectorcardiography will be applied thoughtfully to identify disease as well as to identify those at risk for arrhythmias including the parts of the Nordic ARVD/C cohort, the Rochester ARVD/C cohort, the Lund Stroke Registry and the Rochester Long QT registry. Furthermore, visually estimated/calculated measures including derived-VCG and novel methods will be
converted to automated measures with the assistance of the Glasgow Algorithm and utilized in further cohorts.