Comparison of Three T-end Delineation Algorithms Based on Wavelet Filterbank, Correlation and PCA

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There is a large interest in analyzing the QT-interval, as a prolonged QT-interval can cause the development of ventricular tachyarrhythmias such as Torsade de Points. One major part of QT-analysis is T-end detection. Three T-end delineation algorithms have been developed and applied to Physionet QT database (2-Lead 250Hz) and Through QT Study #2 from Telemetric and Holter ECG Warehouse (THEW) (24-Hour 12 Leads 1000Hz). First method (WTDM) is wavelet based, detecting the maximum of the T-wave by evaluating detail coefficients of a stationary wavelet transform. Starting from the detected maximum, T-end is calculated by a linear tangential approach to the ECG baseline. Methods, based on correlation (CTDM) and PCA (PTDM) need a template for T-end detection. This template, generated by a window starting at the R-peak of an RR-interval and ending at 70% of the RR-interval is cut out for a lage number of heart beats. These T-wave containing signals are used to calculate the template as the mean. Thus, a patient related template is found, in which a precise T-end can be marked. For CTDM the template is correlated to every RR-interval in the ECG-record, while it is stretched and shifted. The best correlation in the interval is used to mark T-end as T-end of the template. PTDM uses PCA to get the best stretch- and shift factors for every heart beat. T-end can than be calculated by the stretched and shifted template similar to CTDM. All algorithms were tested at Physionet QT database with good results, while PTDM produced better results than WTDM and CTDM got best results. Standard derivation in sampling points (fs=250Hz) have been 33.4 WTDM, 8.1 PTDM and 7.8 CTDM. In a second validation we were able to detect 5-10ms QTc-prolongation in a double delta QTc study from THEW with Moxifloxacin. It could be seen that WTDM is prone to interference while CTDM works most stable even under bad conditions.