Average T-wave Alternans Activity in Ambulatory ECGs

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T-wave alternans (TWA) is an index of susceptibility of sudden cardiac death (SCD). A common approach for ambulatory TWA testing is to quantify the maximum TWA amplitude in an ECG, which requires visual verification to discard erroneous measurements caused by noise.

This work presents a fully-automated method to analyze TWA in ambulatory ECGs. It consists of three stages: 1) selection of signal segments which are suitable for automatic analysis, 2) estimation of TWA amplitude in those segments, using a multilead scheme that combines the technique of periodic component analysis with the Laplacian likelihood ratio method for TWA analysis, and 3) computation of indices reflecting the average TWA activity through the record.

A total of 650 24-hour Holter recordings from chronic heart failure (CHF) patients with sinus rhythm were analyzed. Different indices were computed: the Average Alternans Indices (AAIx), which reflected the average TWA activity in those ECG segments with an average heart rate (HR) between X-10 beats per minute (bpm) and X bpm, and the Maximum Alternans Indices (MAIx), which reflected the maximum TWA amplitude in segments with an average HR between X-10 bpm and X bpm.

Mean values of AAIx consistently increased with HR: AAI70 = 2.8 +/- 1.9 uV, AAI80=3.3+/-2.3 uV, AAI90 = 3.9 +/- 2.4 uV, AAI100 = 5.0 +/-3.1 uV and AAI110 = 6.1 +/- 5.5 uV. The AAIx increase between consecutive HR bins was significant in all cases. On the contrary, mean values of MAIx did not consistently increase. Cox proportional hazards analyses showed that average TWA activity predicted SCD when measured between 80 and 90 bpm (AAI90), with a hazard ratio of 1.07 (1.01-1.15) per uV, whereas MAIx indices did not predict SCD.

These results indicate that the average TWA activity over a 24-hour period provides important prognostic information in patients with CHF.