Ultra-high-frequency electrocardiography

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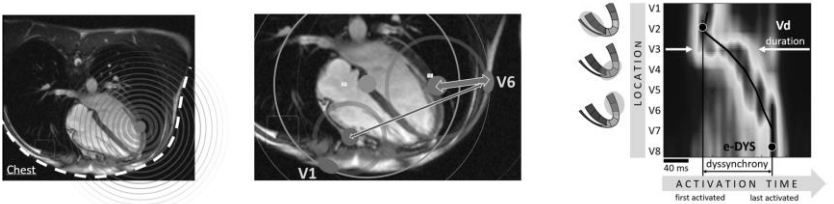
Background: Electrocardiography (ECG) is a technique more than 100 years old. The parameters obtained from the ECG are derived from various morphologies of individual waves in the low-frequency ECGs (P, QRS, and T). We introduce a new technology that uses the ultra-high-frequency components (150-1000 Hz) of the ECG (UHF-ECG).
Method: The UHF-ECG components represent weak signals generated during depolarization of myocardial cells (phase 0 of action potential). The amplitude of UHF oscillations decreases with distance from the source. This property and the different timing of depolarization in the ventricles' volume enable to map the ventricular activation from the chest ECG leads. Because of a low signal-to-noise ratio of UHF oscillations, averaging in both the time and frequency domains must be used. One recording thus lasts 30 seconds and more.



Results: UHF-ECG defines the time-spatial distribution of myocardial electrical activity. Corresponding numerical parameters are electrical dyssynchrony (e-DYS) and the duration of local depolarization (Vd). UHF ventricular depolarization maps present details of electrical activation.
Conclusion: The UHF-ECG uses a new source of information originated in ventricular volumes that is different from the standard ECG. It is possible to map the volumetric electrical activation associated with mechanical contraction. Its primary clinical utilization is in cardiac resynchronization, pacing optimization, and conduction system pacing.