Dynamics of Ventricular Electrophysiology are Unmasked through Noninvasive Electrocardiographic Imaging

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Dynamic variability of ventricular activation and recovery can be a physiological phenomenon, but is also known to increase susceptibility to arrhythmias. It has been extensively studied on the 12-lead electrocardiogram (ECG), but subtle (patho)physiological variations may be challenging to detect and localize due to the limited spatial resolution. Electrocardiographic imaging (ECGI) could be a useful noninvasive high-resolution mapping technique to investigate ventricular dynamics in more detail. Ventricular activation and recovery times (ATs and RTs) were examined using ECGI in 10 normal subjects. Zero-th order Tikhonov regularization was used in combination with a spatiotemporal estimation method to determine ATs and RTs. Dynamics were determined by calculating the standard deviation (SD) of ATs and RTs over three beats. Three consecutive beats and three beats within minutes from each other were analyzed, for each subject. Dynamics were higher for recovery than for activation. Left ventricular areas were less dynamic than right ventricular areas. Dynamics within minutes were similar to dynamicity of consecutive beats. In two subjects, ventricular ectopy was recorded, which led to a pronounced and inhomogeneous increase in dynamicity. These results provide an important basis for future research on ventricular dynamics, such as T-wave variability and rate-dependent aberrant conduction, and their relation to arrhythmias.