

Phase statistics approach to human ventricular fibrillation

Ming-Chya Wu^{1,2,3}

¹Research Center for Adaptive Data Analysis, National Central University, Chungli 32001, Taiwan

²Institute of Physics, Academia Sinica, Nankang, Taipei 11529, Taiwan

³Department of Physics, National Central University, Chungli 32001, Taiwan

Ventricular fibrillation (VF) is known to be the most dangerous cardiac arrhythmia, frequently leading to sudden cardiac death (SCD). During VF, cardiac output drops to nil and, unless the fibrillation is promptly halted, death usually ensues within minutes. While delivering life saving electrical shocks is a method of preventing SCD, it has been recognized that some, though not many, VF episodes are self-terminating, and understanding the mechanism of spontaneous defibrillation might provide newer therapeutic options for treatment of this otherwise fatal arrhythmia. Using the phase statistics approach, recently developed to study financial and physiological time series, here, we reveal the timing characteristics of transient features of ventricular tachyarrhythmia (mostly VF) electrocardiogram (ECG) and find that there are three distinct types of probability density function (PDF) of phase distributions: uniform (UF), concave (CC), and convex (CV). Our data show that VF patients with UF or CC types of PDF have approximately the same probability of survival and nonsurvival, while VF patients with CV type PDF have zero probability of survival, implying that their VF episodes are never self-terminating. Our results suggest that detailed phase statistics of human ECG data may be a key to understanding the mechanism of spontaneous defibrillation of fatal VF.

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e-mail: mcwu@ncu.edu.tw