Demonstration of circadian rhythm in heart rate turbulence using novel application of correlator functions.

BACKGROUND: Demonstration of a circadian rhythm in two parameters of heart rate turbulence--turbulence onset (TO) and turbulence slope (TS)--has been difficult. OBJECTIVE: The aim of this study was to devise a new method for detecting circadian rhythm in noisy data and to apply it to selected Holter recordings from two postmyocardial infarction databases: Cardiac Arrhythmia Suppression Trial (CAST, n = 684) and Innovative Stratification of Arrhythmic Risk (ISAR, n = 327). METHODS: For each patient, TS and TO were calculated for each hour with >4 ventricular premature contractions (VPCs). An autocorrelation function $\text{Corr}(\Delta t)$ was calculated and averaged over all patients. Positive $\text{Corr}(\Delta t)$ indicates that TS at a given hour and $\Delta t$ hours later are similar. TO was treated likewise. Simulations and mathematical analysis showed that a circadian rhythm required $\text{Corr}(\Delta t)$ to have a U-shape consisting of positive values near $\Delta t = 0$ and 23 and negative values for intermediate $\Delta t$. Significant deviation of $\text{Corr}(\Delta t)$ from the correlator function of pure noise was evaluated as a Chi-square value. RESULTS: Circadian patterns were not apparent in hourly averages of TS and TO plotted against clock time, which had large error bars. However, their correlator functions produced Chi-square values of approximately 10 in CAST (both $P<.0001$) and approximately 3 in ISAR (both
P<.0001), indicating the presence of circadian rhythmicity. CONCLUSION: Correlator functions may be a powerful tool for detecting the presence of circadian rhythms in noisy data, even with recordings limited to 24 hours.