

Tracking the Effect of Ibutilide on Amplitude and Frequency of Fibrillatory Intracardiac Electrograms Using the Regression Analysis

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Abstract : Background: Catheter ablation is an effective therapy for symptomatic atrial fibrillation (AF). The intracardiac electrocardiogram (IEGM) collected during this procedure contains precious information that has not been explored to its full capacity. Novel processing techniques allow looking at these recordings from different perspectives which can lead to improved therapeutic approaches. In our previous study, we showed that variation in amplitude measured through Shannon Entropy could be used as an AF recurrence risk stratification factor in patients who received Ibutilide before the electrograms were recorded. The aim of this study is to further investigate the effect of Ibutilide on characteristics of the recorded signals from the left atrium (LA) of a patient with persistent AF before and after administration of the drug. Methods: The IEGMs collected from different intra-atrial sites of 12 patients were studied and compared before and after Ibutilide administration. First, the before and after Ibutilide IEGMs that were recorded within a Euclidian distance of 3 mm in LA were selected as pairs for comparison. For every selected pair of IEGMs, the Probability Distribution Function (PDF) of the amplitude in time domain and magnitude in frequency domain was estimated using the regression analysis. The PDF represents the relative likelihood of a variable falling within a specific range of values. Results: Our observations showed that in time domain, the PDF of amplitudes was fitted to a Gaussian distribution while in frequency domain, it was fitted to a Rayleigh distribution. Our observations also revealed that after Ibutilide administration, the IEGMs would have significantly narrower short-tailed PDFs both in time and frequency domains. Conclusion: This study shows that the PDFs of the IEGMs before and after administration of Ibutilide represents significantly different properties, both in time and frequency domains. Hence, by fitting the PDF of IEGMs in time domain to a Gaussian distribution or in frequency domain to a Rayleigh distribution, the effect of Ibutilide can easily be tracked using the statistics of their PDF (e.g., standard deviation) while this is difficult through the waveform of IEGMs itself.

Keywords : atrial fibrillation, catheter ablation, probability distribution function, time-frequency characteristics

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