QRS Complex Analysis using Wavelet Transform and Two Layered Self-Organizing Map

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Purpose: Many kinds of methods have been developed to classify QRS complex in Holter electrocardiogram. However, the accuracy of these methods is not fully satisfied the clinical needs. In this paper, we developed automated classification methods using a wavelet transform and two-layered self-organizing map (SOM) to improve the accuracy and evaluated. Methods: A discrete wavelet coefficient is used for feature extraction of a heart beat. SOM is used for learning and clustering of signal features. First, each beat is divided in eight sections and the discrete wavelet coefficients of level 1-5 are calculated using a Haar mother wavelet for each section. By learning these wavelet coefficients in the first SOM, each section is mapped in a two-dimensional lattice depending on the characteristics. Second, QRS complexes are reconstructed as a line of the map position in the first SOM and classified by the second SOM. We evaluated our method using MIT-BIH Arrhythmia database of 16 cases (32,032 beats) and compared with the accuracy of a standard cross correlation coefficient method. Five kinds of beat cords of normal, VPC, right bundle branch block, left bundle branch block and WPW are used for the comparison. We defined the error rate Er by the following equation for a qualitative result comparison, Er=Eb/Tb where Eb is the number of the classification error beats and Tb is the total number of beats. Results: The classification error rate in the case of the correlation coefficient method is 0.82% and proposed method is 0.39%. We confirmed that the accuracy of in our method for the QRS complex analysis is significantly improved.