Detection of First-degree Atrioventricular Block on Variable-length Electrocardiogram via a Hierarchical Deep Learning Method

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Aims: Atrioventricular block (AVB) is a type of heart block between the atria and ventricles. First-degree AVB (I-AVB) is possibly an indicator of more serious cardiac diseases in the future, therefore the precise detection of I-AVB is essential in automatic electrocardiogram (ECG) analysis. In this work, we propose an end-to-end deep learning method to detect I-AVB from 12-lead variable-length ECG and achieve state-of-the-art performance.

Methods: We propose a novel hierarchical deep learning algorithm. To handle variable-length ECG records, each ECG record is first divided into 6-second segments and each segment is predicted individually. For each 6-second segment, a well-designed neural network, composed of convolutional neural networks (CNN) and Long Short-Term Memory (LSTM), is used to extract features and give multiple predictions through time. Then, these predictions are combined as the prediction of the 6-second segment. Finally, the predictions of all segments are added together to yield the prediction of the record.

Results: Dataset of ICBEB2018, containing 704 I-AVB records and 6173 other records, is used to evaluate our method. A f1 score of 0.894 is yielded by five-fold cross validation, better than the baseline method.

Conclusion: Experimental results show that the developed method can automatically detect I-AVB on variable-length ECG records with state-of-the-art accuracy.