Wavelet Transform Based Detection of First-degree Atrioventricular Block

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Introduction: First-degree atrioventricular block (AVB I) is a pathology defined on ECG by a PR interval greater than 200 msec.

Aim: This paper aims to automatically detect of AVB I by measuring the length of the PR interval.

Method: Our method consists of the following steps: a) Records with atrial fibrillation or atrial flutter were excluded from the evaluation because there is no P wave. b) QRS complexes were detected. c) QRS onset and T offset were detected for each ECG cycle. The median distance between the QRS onset and the end of the previous T-wave is calculated (it is marked as X). d) QRS complexes were aligned and clustered according to morphological similarity. QRS complexes of the most frequent morphology were averaged. e) QRS onset and offset was detected for the averaged QRS. The signal between QRS onset and offset was replaced by a line intersected by the QRS onset and offset points. This signal was transformed by a wavelet transform. f) The P wave was detected in the transformed signal in the section from QRS onset minus X to QRS onset minus 10 msec. The P onset was detected in the section from QRS onset minus X to the P wave position. g) AVB I was detected when the PR interval was longer than 200 msec. According to the medical definition, this threshold was determined and was not optimized according to the results on individual databases.

Results: The algorithm presented above was set up and validated on private data (MDT, s.r.o., Brno, Czech Republic). This dataset contains 1508 single-lead ECG, of which 758 records are AVB I. The algorithm was tested on publicly available databases. The proposed algorithm achieves sensitivity 0.81, 0.81, 0.82, 0.84 and specificity 0.91, 0.90, 0.86, 0.93 for CPSC, CPSC-Extra, PTB-XL and Georgia database, respectively.