Novel Classification of Ischemic Heart Disease Using Artificial Neural Network

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Ischemic heart disease (IHD) is a pathological condition characterized by inadequate supply of blood and oxygen to a portion of the myocardium, presenting a silent behavior before heart attack. Recently, it seems that machine-learning methods applied to parameters extracted from heart rate variability (HRV) signal could be a useful support in the early diagnosis of some cardiac diseases. However, until now, IHD patients were identified using Artificial Neural Networks (ANN) applied to a limited number of non-linear HRV parameters and only to very few subjects.

To assess this result on a large sample of subjects and to evaluate which features applied to ANN could discriminate this disease, we examined the performances of several ANNs applied to fifteen HRV parameters together with age and gender information. Three different combinations of ANN inputs were considered using features extracted by principal component analysis (PCA), stepwise regression or all the seventeen parameters. We examined the RR time series of 681 normal subjects and 284 ischemic patients acquired along 24 hours, calculating ten linear and five non-linear HRV parameters. The number of hidden neurons ranged from 2 to 6 and training and test sizes were respectively 75% and 25% of the total cases. For each of the three situations we examined 100 combinations of inputs, randomly extracted from available data.

By using PCA, we selected the fifth most significant components, explaining over the 90% of system variability while, applying stepwise regression, we selected the five significant features (meanRR, LFn, SD1, gender and age). The ANNs with the highest accuracy presented 4, 2 or 3 hidden neurons in the three situations, respectively. The ANN with the five parameters selected by stepwise method achieved the highest performance (accuracy=82%), highlighting the powerful capability of ANN to differentiate normal from IHD patients.