

Categorization of Continuous ECG-based Risk Metrics for Cardiovascular Death using Asymmetric and Sample Size Entropy-Based Method

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Categorization of continuous clinical variables into groups such as high, medium or low risk is useful for risk stratification and to guide therapy in patients. In this study, we investigated an asymmetric entropy-based approach to select cutoffs for such categorizations. The proposed asymmetric entropy based method automatically selects cutoffs while addressing the problems of unbalanced class representation in the data set and the asymmetric misclassification costs of false negatives and false positives. We tested the algorithm for categorization of three electrocardiographic based risk metrics for prediction of cardiovascular mortality, heart rate variability (HRV LF-HF), morphological variability (MV) and deceleration capacity (DC). The number of cutoffs derived using asymmetric entropy was same as those used in the literature for risk stratification for cardiovascular deaths. We evaluated the categorization performances of each set of cutoffs using a composite score derived from the product of sensitivities and specificities between any two risk-groups. We derived the cutoffs using a training set containing 1067 patients, and evaluated them on a separate set of 1066 patients. Both the training and test sets were drawn from a study of patients with non-ST-elevation ACS. For MV, the literature based cutoff, 52.5, had a mean score of 0.655. Our method yielded a mean cutoff value of 45 with a mean score of 0.656. For DC, the literature-based cutoffs, 2.5 and 4.5, had a mean score of 0.60, while our method generated 4.2 and 6.0 as the two cutoffs with a significantly higher ($p < 0.05$) mean score of 0.73. For HRV LF-HF the performance of the single cutoff drawn from the literature (cutoff: 0.95; score: 0.62) was significantly ($p < 0.05$) better than that of the cutoff derived using asymmetric entropy (mean cutoff: 1.8; score: 0.56). However, when asymmetric entropy was used to derive two cutoffs, it yielded cutoffs of 0.8 and 2.0 with a mean score of 0.75. This suggests that a three-way categorization based on cutoffs identified by our proposed method might be of clinical utility.