Machine Learning for Prehospital Electrocardiogram Diagnosis of Acute Coronary Syndrome

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Background. Diagnosing Acute Coronary Syndrome (ACS) in chest-pain patients is crucial for making the correct early decisions and preserving cardiac function as much as possible. As recommended in the guidelines, serial electrocardiography may contribute to identifying ACS by detecting acute individual electrocardiographic changes. The aim of this study is to assess the ability of machine-learning-based methods to identify ACS by using serial electrocardiography.

Methods. Data are comprised of 10-second-ECG pairs (ambulance ECG and an earlier ECG recorded in stable condition) from 1425 chest pain patients (213 case-patients later diagnosed with ACS, and 1212 control-patients with other diagnoses). Each ambulance ECG was characterized by 18 direct measurements (DM), and each ECG pair was characterized by 28 serial features (SF; differences between the ambulance ECG and the earlier ECG). Training datasets (70% of the data) were used to build diagnostic models with seven well-established machine-learning algorithms; testing datasets were used to evaluate their performance. Class imbalance was maintained in all datasets. Performance of the machine learning methods was assessed by the testing sensitivity of the receiver operating characteristic corresponding to a specificity of 85%.

Results. DM testing sensitivity values ranged between 85% and 98%, while the testing sensitivities related to the combined DM and SF showed significantly (P value = 0.003) higher values ranging between 86% and 100%. The best machine-learning method was the K-nearest neighbor algorithm (Table).

Conclusions. This study underscores the potential importance of including an early-made ECG in diagnosing ACS in ambulance ECGs. Further studies are recommended to assess this approach in the clinical setting and to evaluate long-term impact on healthcare outcomes.

Sensitivities of machine-learning algorithms by using direct measurements (DM) with or without serial features (SF).

	LDA	DT	SVM	ANN	LR	NBC	KNN
DM	93	94	85	86	98	95	98
DM+SF	95	87	99	86	95	89	100

LDA: linear discriminant analysis, DT: decision tree, SVM: support vector machine, ANN: artificial neural networks, LR: logistic regression, NBC: naïve Bayes classifier, KNN: K-nearest neighbor algorithm.