Within-Patient Correlation Influence on Defibrillation Outcome Prediction using a Bayesian Classifier

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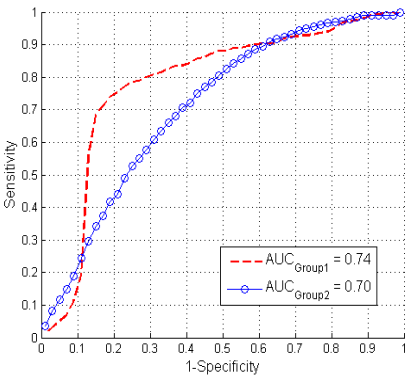
In Out of Hospital Cardiac Arrest (OHCA), information is needed regarding the duration of the untreated Ventricular Fibrillation (VF). The non-invasive measurement of VF parameters allows prediction of a successful defibrillation in order to prioritize interventions: chest compression or defibrillation first. In this study, we evaluate the ability of a given outcome predicton model to discriminate "Success" versus "No success" at 5 s after shock. To build this model, predictors are extracted from Detrended Fluctuation Analysis (DFA) and a Gaussian Mixture Model (GMM) based Bayesian classifier is applied. We examine whether it is reliable to use all successive shocks from one patient for the development of this model. As already reported by other research teams, successive shocks in one patient should be considered as dependent events.

A cross-validation analysis was performed independently on 136 first shocks (Group1) and 382 second and later shocks (Group2). At 5 s post-shock, an organised rhythm (OR) was considered as "Success" and VF was defined as "No success". A 4.1 s interval of pre-shock VF signal was analyzed using a set $\vec{v}$ of features from time and non-linear dynamics (DFA) domains. A GMM-based Bayesian classifier, with probability density estimated by the Expectation Maximization (EM) algorithm was applied in order to detect shocks with "Success" according to the probability $P_{Success}(\vec{v})$.



ROC curves showing performance results obtained for Group1 and Group2

A decrease in performance of discrimination of OR vs VF at 5 s post-shock between Group1 and Group2 is observed with an Area Under the ROC Curve (AUC) of 0.74 (95% CI=0.71-0.78) and 0.70 (95% CI=0.69-0.72), respectively.

As a conclusion this defibrillation outcome prediction model should not be derived from all successive shocks of patients from the database. This corroborates the current hypothesis that within-patient correlation affects defibrillation outcome prediction accuracy.