ECG characteristics of Pulseless Electrical Activity associated with Return of Spontaneous Circulation in Out-of-Hospital Cardiac Arrest

Andoni Elola¹, Elisabete Aramendi¹, Unai Irusta¹, Erik Alonso¹, Pamela Owens², Mary Chang², Ahamed Idris²

UT SOUTHWESTERN
MEDICAL CENTER

¹BioRes, University of the Basque Country UPV-EHU (Bilbao)

²Dallas-Fort Worth Center for Resuscitation Research, University of Texas Southwestern Medical Center UTSW (Dallas)

INTRODUCTION

Predicting the prognosis of Pulseless Electrical Activity (PEA) would allow optimally directing resuscitation efforts. There are contradictory results in the literature about initial characteristics of PEA and their association with Return of Spontaneous Circulation (ROSC).

The objective of this study was to analyse ECG characteristics of PEA that predict ROSC.

MATERIALS AND METHODS

Data collection

Data from 173 out-of-hospital cardiac arrest patients were extracted, all of them recorded by DFW Center for Resuscitation Research (UTSW, Dallas) using the Philips HeartStart MRx device. Artifact free ECG segments of PEA, duration of 5 s, were extracted. From the noROSC patients 1113 PEAs not leading to ROSC were considered from the last 10 minutes of the episodes; PEA segments with good prognosis were extracted from the last 10 min prior to the time of ROSC onset annotated by clinician on scene, a total of 326.

Methods

Three features were automatically extracted to characterize the waveform of the ECG:

- Heart rate
- Mean Slope (MS)
- Amplitude Spectrum Area (AMSA)

Logistic Regression (LR) classifiers were applied using a patient-wise 10-fold cross validation scheme to compute the probability of a positive prognosis (p). The performance was evaluated in terms of Sensitivity (Se), Specificity (Sp) and Area Under the Curve (AUC).

Figure 1. PEA segments of 5 s that did not lead to Pulsed Rhythm (PR) on the top and PEA examples that did lead to PR on the bottom.

RESULTS

The individual distributions and scores of the features are shown in the table, as median (first quartile-third quartile). The overall Se/Sp/AUC of the LR was 80.3%/78.6%/0.85, slightly above the best individual feature (AMSA).

	No ROSC	ROSC	Se/Sp/AUC
Rate	44.2 (28.8-73.9)	57.2 (33.4-96.2)	71.7%/28.1%/0.56
MS	1.9 (1.3-3.0)	4.2 (2.9-8.2)	75.6%/75.6%/0.80
AMSA	14.8 (10.5-20.9)	37.3 (27.0-59.9)	77.0%/78.5%/0.84

Figure 2. Posterior probabilities of ROSC for noROSC patients (left) and ROSC patients (right) in function of time to ROSC. Probabilities are given for each feature and for the combination of them in a Logistic Regression model (LR).

CONCLUSIONS

- ① ECG features are good predictors of the evolution of PEA to ROSC
- ② AMSA was the best individual feature (AUC= 0.84)
- ③ The combination of ECG features in a logistic regression model improved the accuracy of the predictor.