

# Risk Assessment of All-Cause Mortality in ICD Patients Using a Novel QRS Fragmentation Score

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**Introduction** Fragmented QRS complexes (fQRS) are QRS complexes with one or more deflections. They are known risk factors for cardiac events in several patient groups. Detection is done visually, which is a time-consuming process that may lead to subjective results, limiting the clinical use of this parameter.

**Methods** We propose an automated method to calculate an fQRS score which gives an indication of the severity of fQRS in a channel. To compute the score, 10 features are calculated using Phase Rectified Signal Averaging and Variational Mode Decomposition and used as input for an SVM classifier.

The fQRS score is then used to assess the risk of all-cause mortality in a dataset of patients with an implanted cardioverter defibrillator. An optimal cut point is defined for each channel to dichotomize the fQRS scores. Bootstrapping is used to reduce variability in cut point selection.

**Results** Classification results (AUC=0.926) show that the fQRS score succeeds in separating signals with clear QRS fragmentation from normal signals. Results of survival analysis on an independent test set indicate that the fQRS score of 3 channels leads to survival curves with statistically significant differences ( $p < 0.05$ ). The channels which show the most obvious results are in line with results in previous clinical studies.

**Conclusion** This novel way of detecting and quantifying QRS fragmentation is therefore a promising way to promote the clinical usefulness of the parameter.