Instituto Universitario de Investigación en Ingeniería de Aragón
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XII JORNADA DE JÓVENES INVESTIGADORES/AS DEL I3A

Queen Mary University of London

ECG-Based Unsupervised Clustering in Coronary Artery Disease Associates with Ventricular Arrhythmia

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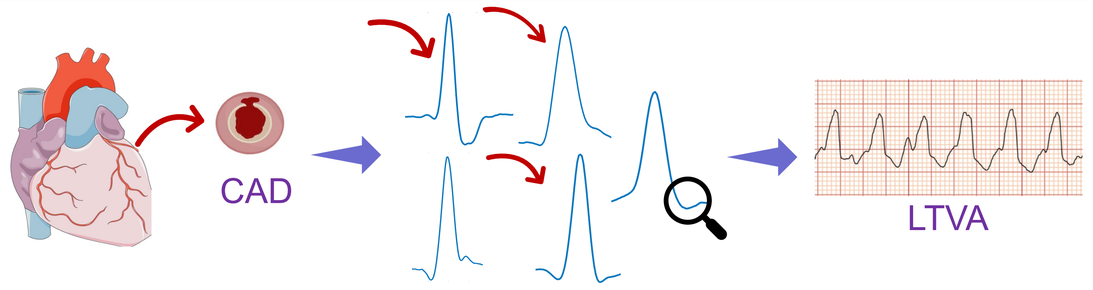
Background

- Coronary Artery Disease (CAD) is a leading cause of life-threatening ventricular arrhythmias (LTVAs).
- The presence of CAD slows ventricular conduction heterogeneously across individuals, manifesting as different QRS morphologies.



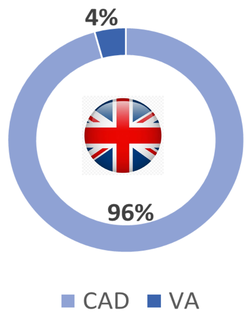
Objective

- This study aimed to identify distinct clusters of CAD individuals based on QRS morphology using unsupervised learning.

UK Biobank Cohort

- The study population consisted of 1,458 individuals diagnosed with CAD in the UK Biobank study. (Application number: 8256)

Population Distribution

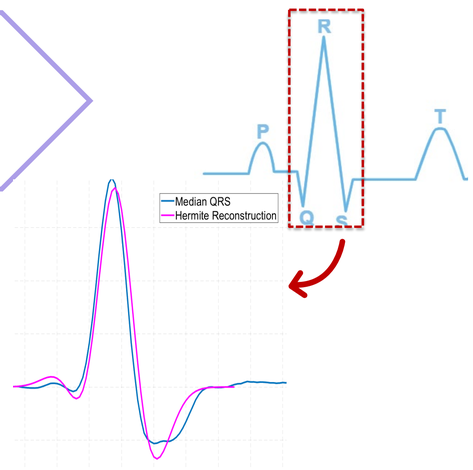


Methods

UK Biobank

Single-lead wavelet-based delineator[1]

1. **Signal Preprocessing and QRS-waves characterization**
   - Extract average heartbeat from 10-seconds I-lead ECGs recorded at rest.
   - Locate QRS-waves delineation marks.
   - Hermite Functions quantify QRS morphology.
   - Calculate standard QRS biomarkers.
2. **Identification of Clusters using QRS Biomarkers**
   - Feature selection by a filter type algorithm
   - K-means clustering based on 3-nearest neighbors.
3. **Statistical Analysis**
   - Chi square tests
   - Kruskal Wallis test
   - Wilcoxon rank test



Results

- Cluster 1 was mainly characterized by lower QRS amplitude, flatter down slopes, and a wider QRS than clusters 2 and 3.
- Significant differences in morphological variations were described by Hermite basis 2, 3 and 5.

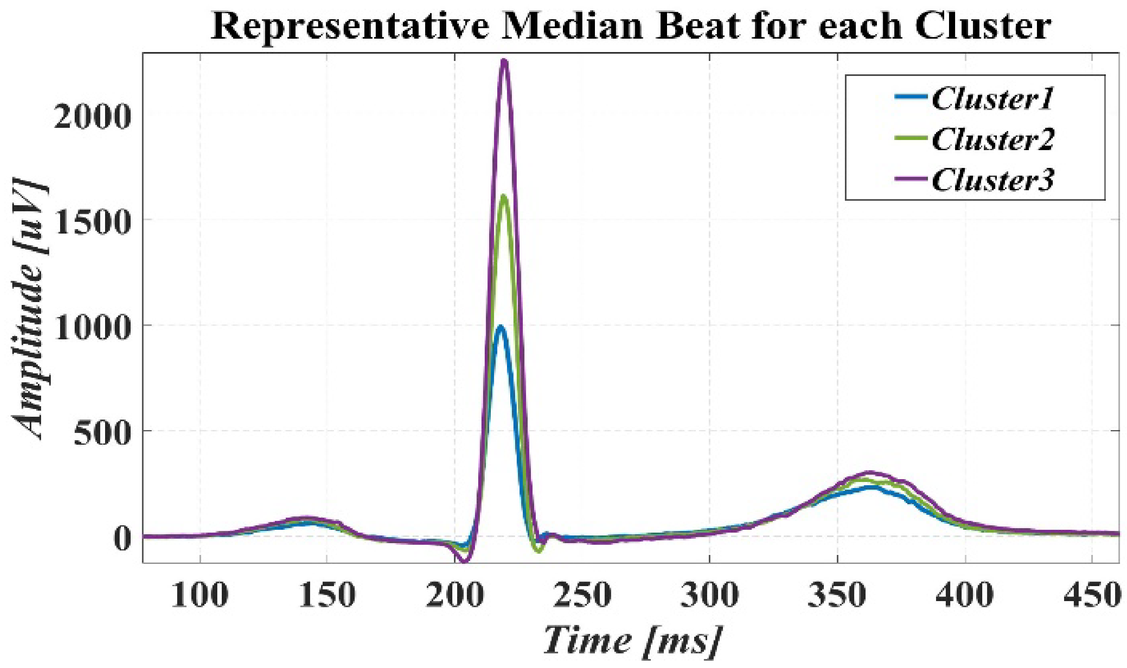
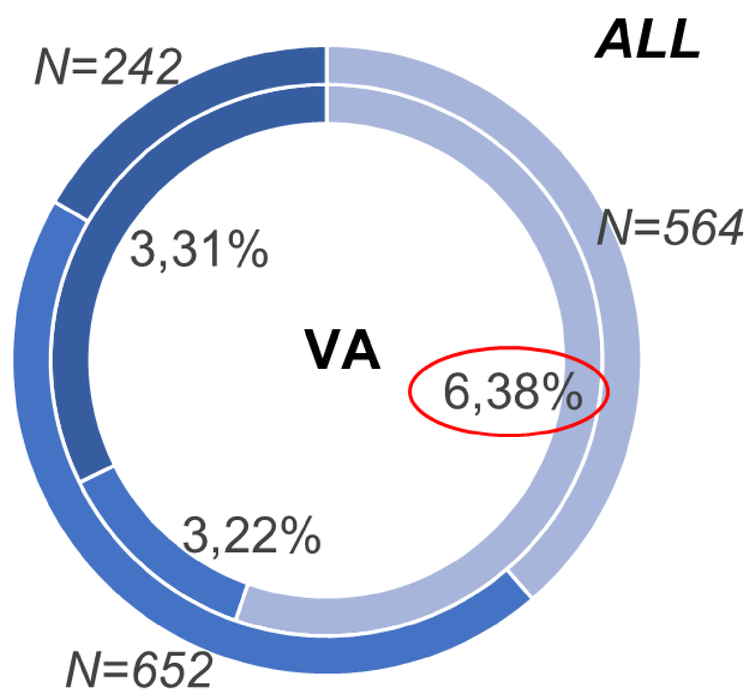


Figure 1. Median beat representative for each cluster obtained by the 3-nearest neighbors clustering algorithm

Clustering Results



Conclusions

- Our analysis has identified in an unsupervised manner three distinct clusters of CAD individuals using the QRS morphology.
- The cluster with the lowest QRS amplitudes and widest QRS complexes was strongly associated with LTVA risk.
- Further studies will investigate the contribution of additional LTVA risk factors in CAD.

References: MARTÍNEZ, J.P. et al. A Wavelet-Based ECG Delineator Evaluation on Standard Databases. In IEEE Transactions on Biomedical Engineering. 2004. Vol. 51, no. 4, s. 570–581.

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