

Machine Learning of AF Electrograms and Clinical Features Predict Acute Termination of Atrial Fibrillation by Ablation

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BACKGROUND

- Although several clinical risk scores and electrogram (EGM) based indices have been individually used to predict AF termination, it remains unclear how to combine clinical and EGM features using machine learning (ML) with higher prediction performance.

HYPOTHESIS

- We hypothesized that combining clinical features and AF organization extracted from EGMs, using unsupervised machine learning (ML) may predict AF termination by ablation.

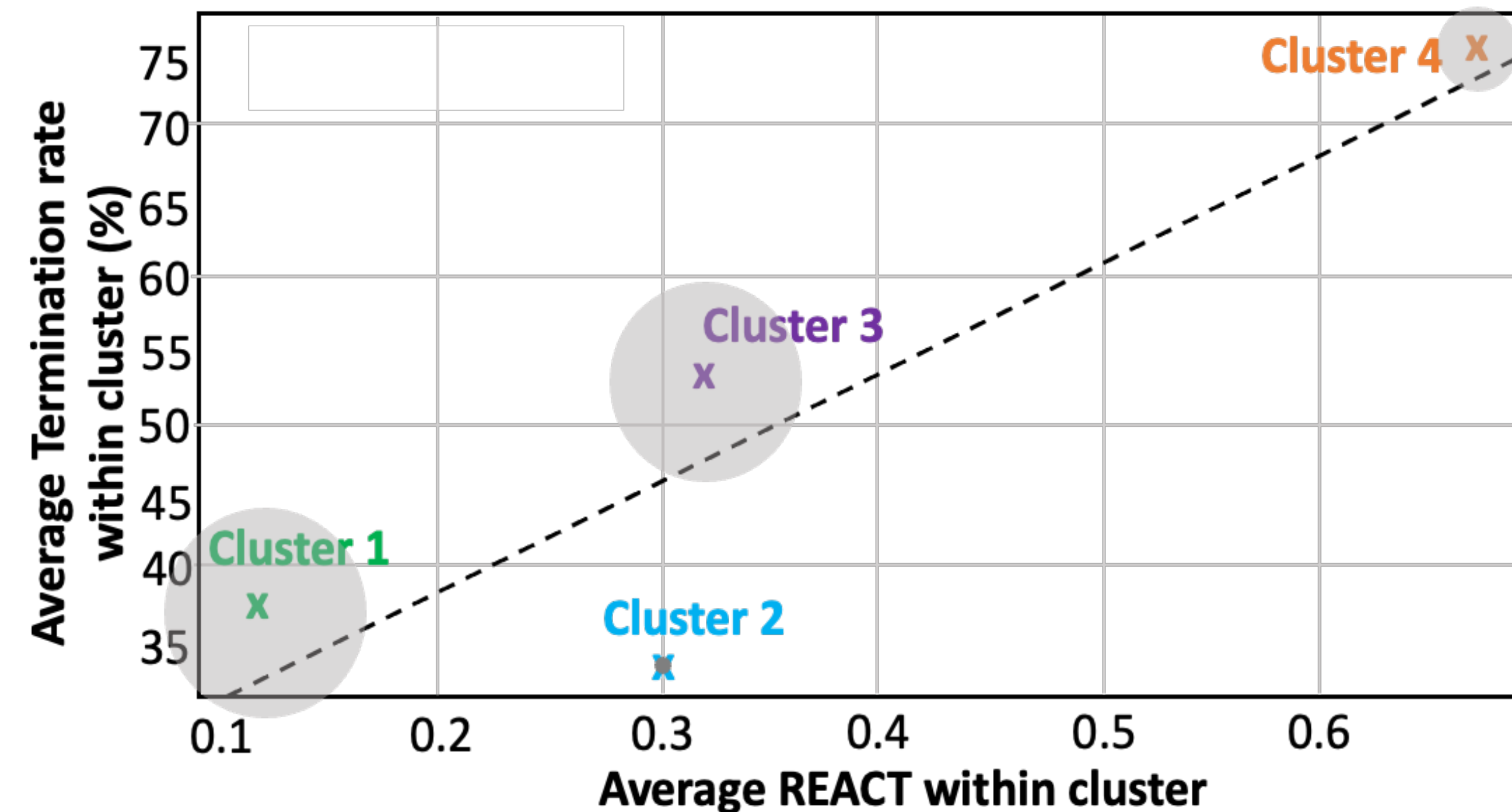
METHODS

- We studied N=150 AF patients (29% F, 64.2±11.0yr), propensity matched into N=75 with AF termination ("Term") by ablation and N=75 without ("Non-term").
- We calculated AF organization using Repetitive activity (REACT) mapping, which correlates unipolar EGMs in 2x2 grids from 64 pole basket recordings, repeated spatially for the entire left atrium (Fig A, B).
- We applied k-means clustering on 50 clinical characteristics plus global-averaged REACT in the N=150 AF patients.
- We studied if this cluster model could predict AF termination.

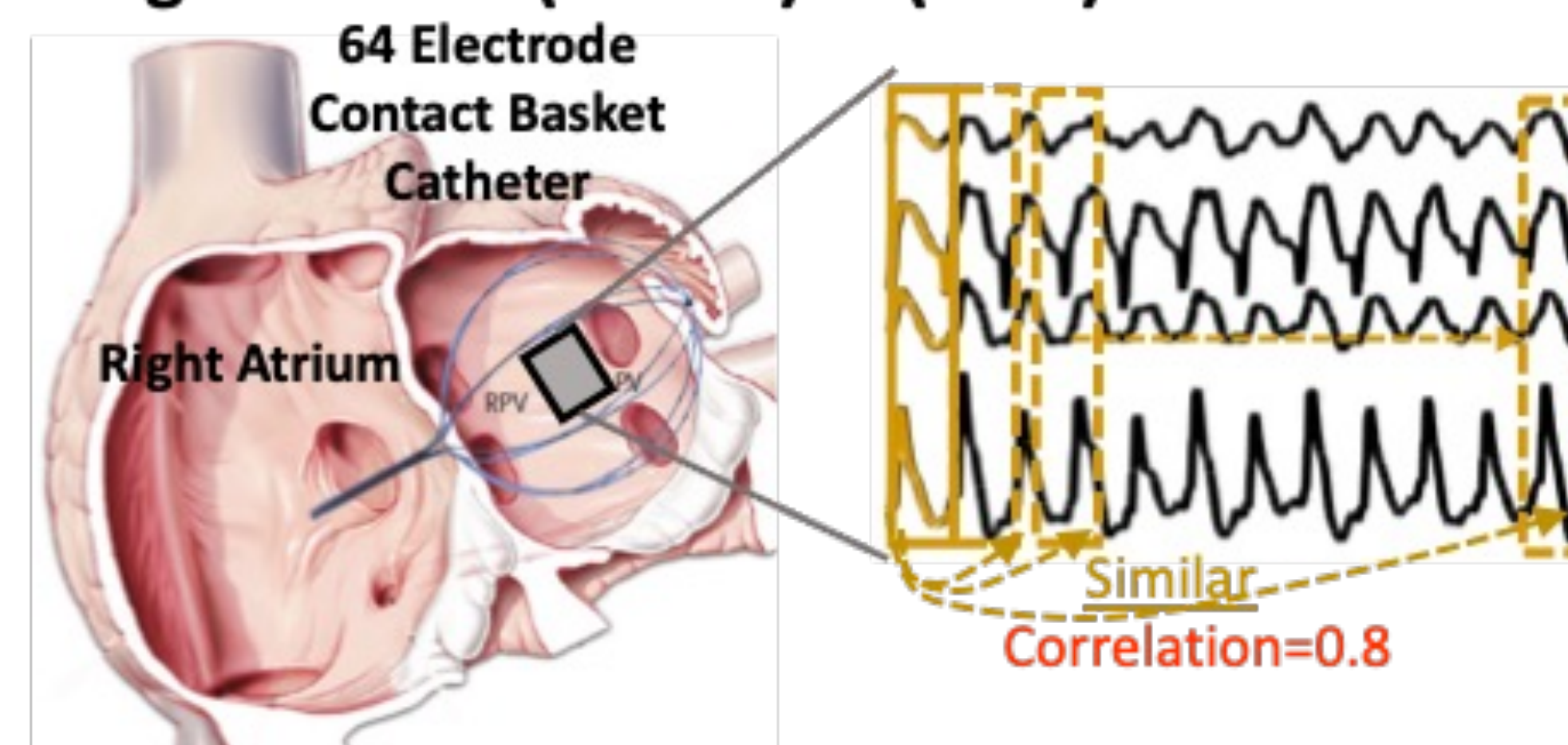
Major Finding

Unsupervised clustering of clinical characteristics and AF electrogram organization defined by repetitive activations (REACT) predicts AF termination better than clinical variables alone.

Fig F. REACT Predicts AF Termination, χ^2 Between Clusters < 0.01



A. Repetitive Activation Regions in AF (REACT) B. 2x2 Unipole EGM (2sec)



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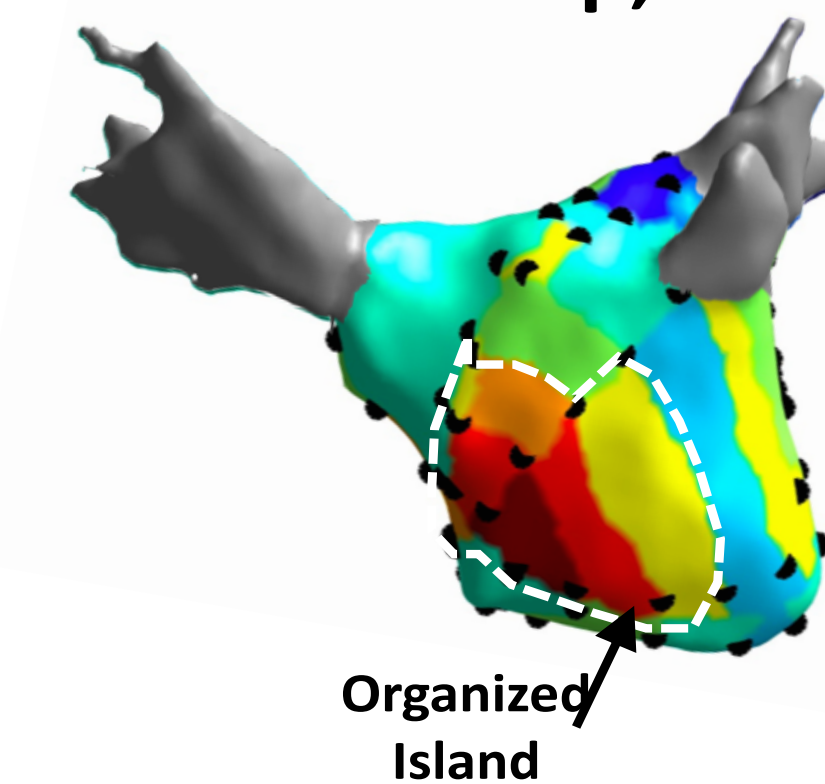
RESULTS

- Fig. C shows REACT in a 65 YO male AF Term and fig D shows in an 85 YO male AF Non-term.
- We identified 4 clusters (fig E) with silhouette index 0.41, indicating good cluster quality. Clusters predicted AF termination as rates of AF termination were significantly different between clusters ($p < 0.01$, χ^2 ; fig F) and directly proportional to REACT in 3 out of 4 clusters.
- N=100 trials with random initializations showed that REACT with clinical variables was more predictive than clinical variables alone (Silhouette index 0.411 ± 0.001 vs 0.336 ± 0.003 , $p < 0.001$).

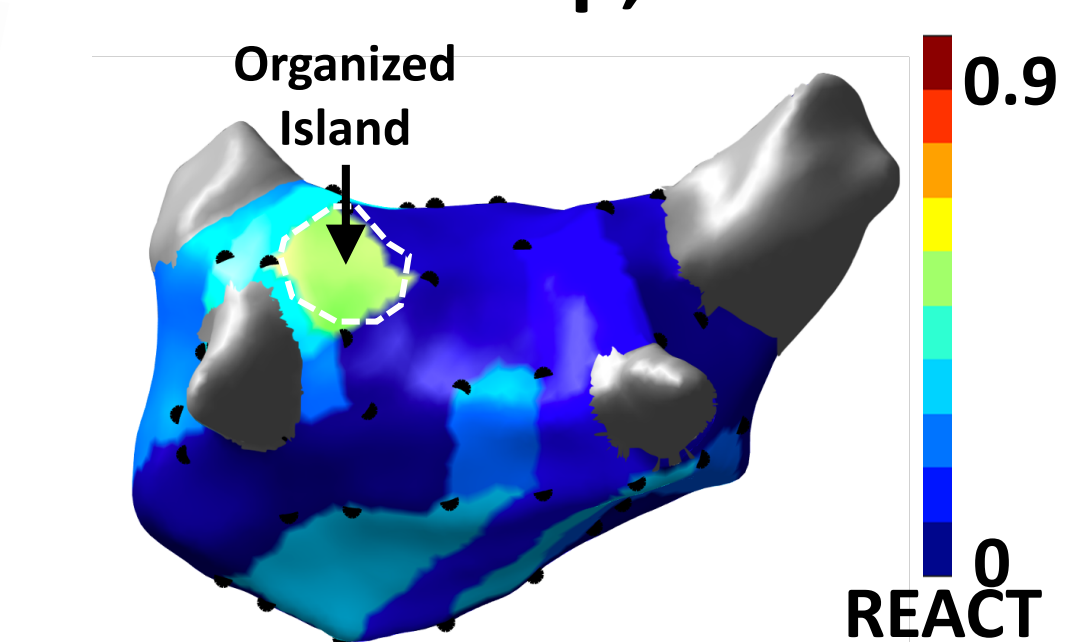
CONCLUSIONS

- Unsupervised clustering of clinical characteristics and electrogram organization predicts AF termination better than clinical scores alone.

C. REACT Map, Term



D. REACT Map, Non-term



E. Clusters using ML of REACT and Clinical Variables

