

A machine-learning algorithm to predict atrial fibrillation recurrence after a pulmonary vein isolation procedure

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Background: Contemporary risk models to predict the recurrence of atrial fibrillation (AF) after pulmonary vein isolation have limited predictive ability. Models with high specificity seem particularly suited for the setting of AF ablation, where they could be used as gatekeepers to withhold intervention in patients with low likelihood of success. Machine learning (ML) has the potential to identify complex nonlinear patterns within datasets, improving the predictive power of models. This study sought to determine whether ML can be used to better identify patients who will relapse within one year of an AF ablation procedure.

Methods: We assessed 484 patients (294 men, mean age 61±12 years, 76% with paroxysmal AF) who underwent radiofrequency pulmonary vein isolation (PVI) for symptomatic drug-refractory AF. Using this dataset, a machine-learning model based on Support Vector Machines (SVM) was developed to predict AF recurrence within one year of the procedure. The following variables were used to feed the model: type of AF (paroxysmal vs. non-paroxysmal), previous ablation procedure, left atrium (LA) volume,

and epicardial fat volume (both derived from pre-ablation cardiac CT). The algorithm was trained in a random sample of 70% of the study population (n=339) and tested in the remainder 30% (n=145).

Results: A total of 130 patients (27%) suffered AF recurrence within one year of the procedure. The ML model predicted AF recurrence with 75% accuracy (95% CI 67–82%), yielding a sensitivity and specificity of 25% (95% CI 13–41%) and 94% (95% CI 88–98%), respectively. The corresponding positive and negative predictive values were 62% (95% CI 39–81%) and 77% (95% CI 67–82%), respectively. The relative weight of the variables in the ML model was: epicardial fat 56%, type of AF 23%, previous ablation 14%, and LA volume 7%. A high-risk subgroup representing 10.8% of patients was identified with the ML algorithm. In this subgroup, one-year recurrence was 62%, representing 24% of the total number of recurrences.

Conclusion: A machine-learning model showed high specificity in the identification of patients who relapse during the first year after AF ablation. In the future, these tools may be useful to improve patient selection.