Machine Learning of Cardiac Computed Tomography Can Predict Success of Atrial Fibrillation Ablation

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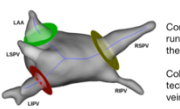
Background: Structural changes in the left atrium (LA) and clinical indexes modestly predict worse outcomes in patients undergoing catheter ablation (CA) for atrial fibrillation (AF). Machine learning (ML) is a promising approach to improve predictive risk models by integrating patient-specific atrial geometry from 2D and 3D cardiac computed tomography (CT) with patient history. themselves, a conclusion. Objective: To study if ML approaches based on a patient's specific clinical data can identify responders to diverse personalised AF therapies, unbiased by traditional mechanistic hypotheses. Methods: This was a retrospective analysis of patients with AF undergoing CA, who had preprocedural CT scans. Demographic data and long term(1-year) freedom from arrhythmia documented were included in the study. LA was segmented from scans using a custom image processing platform. Fig A shows preprocedural CT, which was segmented to delineate surface area, shape and orifices of the pulmonary veins(PVs) and left atrial appendage(LAA). These anatomical features were indicated by coloured disks. ML methods developed for this task were trained to predict AF/AT recurrence (binary, 0/1) with input features of CT anatomy, BMI, age, gender and comorbidities (Fig B). The Binary classification methods used were support vector machine(SVM), Random Forest(RFC), and Logistic Regression(LR).

Results: 211 patients (64±11y, 55% PeAF, 68% male) were split into 70/10/20 training/validation/test sets. Post 10-fold validation, RFC showed the higher combination of accuracy, sensitivity and specificity, 79%, 92%, 70% respectively. Followed by SVM achieving an accuracy of 64%, sensitivity of 72%, and specificity of 27% and LR with 58%, 65%, 25% respectively.Conclusion: Our ML approach provides a baseline method that can be used to predict clinical outcomes. Combining the achieved baseline model with implemented deep feature extraction technique using CNN is needed to achieve better training and validation of this approach, which may help with developing a consistent personalised ablation strategy for AF.

Figure A. Custom image processing platform used for analysing anatomy of atria



Computed centrelines in blue are running from a user selected point to the centre of gravity.

Colourful. Disks represent clipper techniques utilised for deriving veins' anatomical information.

Figure B. Machine Learning pipeline that integrates 2 sources of information for assessing catheter ablation success