Using Machine-Learning for Prediction of the Response to Cardiac Resynchronization Therapy: the SMART-AV Study

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Abstract

Introduction—We aimed to apply machine learning (ML) to develop a prediction model for cardiac resynchronization therapy (CRT) response. Methods and Results—Participants from the SmartDelay Determined AV Optimization (SMART-AV) trial (n=741; age, 66 ±11 yrs; 33% female; 100% NYHA III-IV; 100% EF[?]35%) were randomly split into training & testing (80%; n=593), and validation (20%; n=148) samples. Baseline clinical, ECG, echocardiographic and biomarker characteristics, and left ventricular (LV) lead position (43 variables) were included in 6 ML models (random forests, convolutional neural network, lasso, adaptive lasso, plugin lasso, elastic net, ridge, and logistic regression). A composite of freedom from death and heart failure hospitalization and a >15% reduction in LV end-systolic volume index at 6-months post-CRT was the endpoint. The primary endpoint was met by 337 patients (45.5%). The adaptive lasso model was more accurate than class I ACC/AHA guidelines criteria (AUC 0.759; 95%CI 0.678-0.840 versus 0.639; 95%CI 0.554-0.722; P<0.0001), well-calibrated, and parsimonious (19 predictors; nearly half are potentially modifiable). The model predicted CRT response with 70% accuracy, 70% sensitivity, and 70% specificity, and should be further validated in prospective studies. Conclusions—ML predicts short-term CRT response and thus may help with CRT procedure planning.

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