CI-524-04

RISK OF VENTRICULAR ARRHYTHMIAS FOLLOWING IMPLANTABLE CARDIOVERTER DEFIBRILLATOR GENERATOR CHANGE IN PATIENTS WITH RECOVERED EJECTION FRACTION: IMPLICATIONS FOR SHARED DECISION MAKING

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Background: Primary-prevention ICDs are indicated for most patients with LVEF <35%. Some patients improve their LVEF to >35% during the life of their first ICD. In present practice, when the battery is depleted, ICDs most often are replaced regardless of LVEF. In patients with recovered LVEF who have never received appropriate ICD therapy, the utility of ICD generator replacement remains unclear.

Objective: To evaluate rates of appropriate ICD therapy based on LVEF at the time of generator change, in order to educate shared decision making.

Methods: We enrolled patients with a primary-prevention ICD originally implanted for LVEF <35%, who underwent ICD generator change within our state’s largest multihospital health system. Patients who required appropriate ICD therapy for VT/VF prior to generator change were excluded. Cumulative incidence curves were Fine-Gray adjusted for the competing risk of death.

Results: Among 951 generator changes, 423 patients (69±12 y, 65% men, 29% Black, LVEF 34±15%, 222 [52%] ischemic) met inclusion criteria. Over 3.4±2.2 years after generator change, 78 (18%) received appropriate therapy for VT/VF. Compared to patients with recovered EF >35% (n=161 [38%]), those with LVEF persistently <35% (n=262 [62%]) more likely required ICD therapy (p=0.005; 5-year rates: 13% vs. 25%). ROC analysis (AUC 0.66, p<0.001) revealed the optimal cutoff for VT/VF prediction was LVEF 45%, which was supported by the plot of hazard vs. EF as a continuous variable, modeled by restricted cubic splines. There was much lower VT/VF incidence among those with LVEF >45% vs. <45% (p<0.001); 5-year rates: 6% vs. 25%. These findings were similar for patients with either ischemic or nonischemic cardiomyopathy (HR 3.9, p<0.01; and HR 8.5, p=0.035).

Conclusion: At the time of ICD generator change, patients with primary-prevention ICDs and LVEF >45% with no prior ICD therapy have a significantly lower rate of subsequent ventricular arrhythmias compared to those with LVEF <45%. These data may be useful during shared decision-making at the time of ICD generator battery depletion.

ABSTRACT DH-575:
Deep Learning and AI for Heart Rhythm Disorders
Friday, April 29, 2022
1:00 PM - 2:00 PM

DH-575-01

MACHINE LEARNING-ENABLED MULTIMODAL FUSION OF INTRA-ATRIAL AND BODY SURFACE SIGNALS IN PREDICTION OF ATRIAL FIBRILLATION ABLATION OUTCOMES

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Background: Machine learning (ML) is a promising approach to personalize atrial fibrillation (AF) management strategies for patients after catheter ablation. Prior studies applied classical ML methods to clinical scores, and none have leveraged intracardiac electrograms (EGM) or 12-lead electrocardiograms (ECG) for outcome prediction.

Objective: We aimed to show that (a) ML models trained on EGM or ECG can better predict patient outcomes after AF ablation than existing clinical scores and (b) fusion of EGM, ECG, and clinical features can further improve the prediction performance.

Methods: Consecutive patients who underwent catheter ablation between 2015-2017 with panoramic left atrial EGM prior to ablation and clinical follow-up for at least one year following ablation were included. A convolutional neural network (CNN)
and a fusion framework were developed for predicting 1-year AF recurrence after catheter ablation from EGM, ECG, and clinical features. The models were trained and validated using 10-fold cross-validation.

**Results:** 156 patients (64.5 ± 10.5 years, 74% male, 42% paroxysmal) were analyzed. Using EGM alone, the CNN achieved an Area Under the Receiver Operating Characteristics Curve (AUC) of 0.73, outperforming existing APPLE (AUC = 0.63) and CHA2DS2-VASc scores (AUC = 0.62). Similarly using 12-lead ECG alone, the CNN achieved an AUC of 0.77. Combining EGM, ECG, and clinical features, the fusion model achieved an AUC of 0.87, outperforming single and dual modality models.

**Conclusion:** Deep neural networks trained on EGM or ECG greatly improved the prediction of catheter ablation outcome compared to existing clinical scores, and fusion of EGM, ECG, and clinical features further improved the prediction performance.

**DH-575-02**

**IDENTIFICATION OF SUPRAVENTRICULAR TACHYCARDIA MECHANISMS WITH SURFACE ELECTROCARDIOGRAMS USING A DEEP NEURAL NETWORK**

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**Background:** The current clinical paradigm to diagnose supraventricular tachycardias (SVTs) results in potential overlap between various ECG expressions. Machine learning may identify visually imperceptible ECG changes and augment the predictive accuracy of determining SVT mechanisms.

**Objective:** To compare a Convolutional Neural Network (CNN) with manual SVT identification among atrioventricular nodal re-entrant tachycardia (AVNRT), atrioventricular reciprocating tachycardia (AVRT), and atrial tachycardia (AT).

**Methods:** All patients with a 12-lead ECG of a diagnosed and successfully ablated SVT during an electrophysiology study from 2013-2020 were included. Digital ECG data ≥10 seconds were extracted from the recording system and split into training, validation, and test datasets in a ratio of approximately 7:1:2. The results were reported as the average across 10 random data splits and model initializations for robustness. We then compared the CNN performance with an independent adjudication by an experienced cardiac electrophysiologist.

**Results:** From 763 patients, 1524 ECGs (371 AVNRT, 312 AVRT, 95 AT, and 746 sinus rhythm) were used to develop the CNN. CNN identified 1) AVNRT with a higher sensitivity and similar specificity; 2) AVRT with a lower sensitivity but higher specificity; and 3) AT with a lower sensitivity and similar specificity compared to the adjudicator (Table). The CNN area under the receiver operating characteristic curve for AVNRT, AVRT, and AT was 0.855, 0.880, and 0.774 respectively.

**Conclusion:** In this primary model, CNN allowed differentiating SVT mechanisms characterized by a similar and variably higher or lower performance metrics compared with an experienced electrophysiologist.

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<th>Convolutional Neural Network</th>
<th>Experienced Cardiac Electrophysiologist *</th>
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<td>AUC</td>
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*Including 20 of 100 ECGs with “undetermined answers” from the analysis