IDENTIFICATION OF CONDUCTION PATTERNS DURING ATRIAL FIBRILLATION USING ARTIFICIAL INTELLIGENCE: HOLISTIC FULL CHAMBER VIEW

Nathan A. Angel PhD; Pratik Shah PhD; Derrick Chou PhD and Min Zhu PhD

Background: Atrial fibrillation (AF) is thought to be maintained by reentrant and focal driver regions that may have some spatial-temporal stability. Recently, several cardiac mapping systems have implemented algorithms for automatic detection of these arrhythmogenic conduction patterns (CPs) during AF. Many of these algorithms divide the atrium into overlapping patches, sequentially analyzing each patch with the driver identification algorithms. Patch-based analyses may misrepresent local CPs as the number and trajectory of wavefronts entering and leaving the analyzed patch are uncertain. However, when a holistic view of chamber-wide activation is used, machine learning algorithms can ubiquitously identify arrhythmogenic CPs.

Objective: Develop and evaluate a machine learning approach that can automatically identify and locate arrhythmogenic CPs.

Methods: Propagation maps of clinical AF from nine patients were transformed into a 2D image space using conformal mapping, and these images were used to train and evaluate a UNet architecture model. Rotational and focal CPs were identified by the AcQTrack algorithm (Acutus Medical) and manually confirmed. The clinical dataset was supplemented with eikonal simulations of focally (n = 400) and rotationally driven (n = 200) AF, where the time and location of the rotational and focal drivers were randomized and known. The UNet architecture was trained using five of the clinical AF cases (n = 7,880 frames) and simulated AF (200 focal and 100 rotational simulations, n = 14,380 frames). A test set, consisting of five clinical AF cases (n = 6,172 frames) and simulated AF (200 focal and 100 rotational simulations, n = 14,382 frames), were independently used to evaluate the model performance.

Results: The UNet model accurately detected the time and location of arrhythmogenic CPs in the atrium - Clinical AF DICE 0.91 and Simulated AF DICE 0.98.

Conclusion: The presented machine learning approach can accurately identify and locate arrhythmogenic targets. It has potential to overcome limited view problem in detecting arrhythmogenic targets that is inherent problem of patch-based heuristic algorithms.

CHARACTERISTICS AND OUTCOMES OF FIRST HOSPITALIZATION FOR CARDIAC ARREST IN PATIENTS WITH KNOWN CARDIOMYOPATHY

Effimia Maria Zacharia M.D.; Filip Istvanic M.D. and Samir F. Saba MD, FHRS

Background: Patients with reduced ejection fraction (LVEF ≤50%) are at increased risk of cardiac arrest (CA) due to shockable [polymorphic (PVT) and monomorphic (MVT) ventricular tachycardia; ventricular fibrillation (VF)] or non-shockable [pulsless electrical activity (PEA), and Asystole] rhythms.

Objective: To examine the characteristics and mortality of cardiomyopathy patients admitted with CA by type of arrhythmia.
Methods: From a database of 18,003 cardiomyopathy patients treated at a tertiary care center between 2011 and 2017, 389 (2.2%) were admitted to the hospital with CA and constituted our study cohort.

Results: Of the 389 cardiomyopathy patients admitted with CA, 362 (93%) had documented rhythm: MVT 29, PVT 29, Unspecified VT 27, VF 145, PEA 69, Asystole 40, and unspecified bradyarrhythmia 23. Compared to patients with bradyarrhythmia, those with tachyarrhythmia were less frequently men (31% vs 56%, p=0.027), and more likely to have electrolyte abnormalities (27% vs 5%, p<0.001), new cardiac ischemia (29% vs 10%, p<0.001), frequent PVCs (12% vs 0%, p<0.001), be prescribed new anti-arrhythmic drugs (74% vs 24%, p<0.001), be implanted with a new defibrillator during the index hospitalization (35% vs 4%, p<0.001), but similar rates of utilization of advanced heart failure options (48% vs 50%, p=0.78). Over a median follow-up of 2.8 years, patients with shockable rhythms had better survival (HR=1.49, p=0.002, Figure).

Conclusion: In the context of cardiomyopathy, a minority of patients are admitted with CA, Clinical characteristics, treatment options vary significantly between patients with shockable vs non-shockable rhythms. The former group has a significantly lower mortality.