Using Artificial Intelligence To Predict the Ventricular Origins of Premature Ventricular Contractions Based on 12 Lead EKG Data

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Background: Predicting origins of premature ventricular complexes (PVCs) based on a 12-lead electrocardiogram (EKG) is a laborious process. Artificial intelligence can automate the process more expediently, improving catheter ablation outcomes. Objective: This pilot study is meant to show that deep learning can discern if PVCs originate from 1) the right or left ventricle, and 2) from the base or apex of that ventricle. Methods: Data was sourced from PhysioNet. Three Artificial Neural Networks were trained on multiple databases for PVC recognition from EKG Leads II, V1, and V5. From each detected PVC sample with PVCs present in all three leads simultaneously, an Attention Residual U-net was used to segment the QRS Complex from each beat sample for use on the algorithm. The U-net was trained on the Lobachevsky University Electrocardiography Database. Leads V1 and V5 on the EKG were used to detect RBBB/LBBB PVC morphology, and then axis determination was based on R/S pattern in Lead II. Results: The INCART dataset consisted of 175,667 segmented beats, including 20,005 PVCs. The accuracy of the 3 networks was 94.60%, 99.07%, and 92.58% for Lead II, V1, and V5 respectively. Of the remaining 35 records of the INCART database (10577 PVCs), after identifying each beat's QRS complex, the algorithm was able to group 9,262 (87.6%) of them into the 4 categories. Out of the 9,262 PVCs, 1,602 (17.30%) came from the left apex, 17 (0.18%) from LVOT, 2 (0.02%) from the vicinity of right apex, and 7641 (82.50%) from RVOT. Conclusion: Deep Learning was able to accurately identify PVCs and categorize PVC origin. Further research can be done to optimize the program with more precise localization algorithms and improved PVC recognition.

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