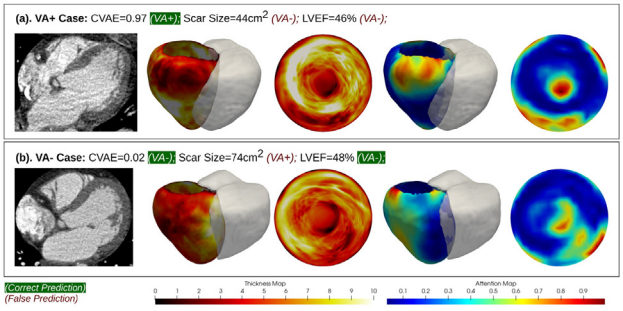
analysis of attention maps confirmed that the CVAE actually used the MI region to predict VA, and showed that the CVAE was filtering out areas of physiological WT, thereby outperforming simple WT thresholding.
Conclusion: Fully automated analysis of WT from CT images is feasible in patients with MI, and allows for the extraction of robust markers of VA, outperforming conventional risk stratifiers.



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ARRHYTHMIC SUDDEN DEATH (SCDA) SURVIVAL PREDICTION USING DEEP LEARNING (DL) ANALYSIS OF CONTRAST-ENHANCED CARDIAC MAGNETIC RESONANCE IMAGING (LGE-CMR)

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Background: Current approaches to SCDA risk prediction represent broad guidelines and fail to incorporate personalized, complex, large-scale clinical data and individualized phenotyping. DL approaches are ideal for such data, however, most of the DL work related to arrhythmia has focused on disease classification and detection from ECG time series data. Furthermore, mechanistically, ventricular arrhythmia in patients with structural heart disease often results from the heterogeneous scar distribution, however, DL on raw imaging scans has not been explored for risk analysis.
Objective: In this work we develop a novel DL approach which blends neural networks (NNs) and survival analysis to predict patient-specific survival curves from raw LGE-CMRs and clinical covariates for patients with ischemic heart disease.
Methods: The approach uses LGE-CMR images with the left ventricle automatically segmented and clinical covariates as inputs to two sub-NNs. Labels associated with each patient - consisting of the observed time to event, and an indicator whether the event was SCDA or non-SCDA - are used as targets during training only. LGE-CMR data is taken as input by a 3-D convolutional NN constructed using an encoder-decoder architecture. Clinical covariates are fed to a dense NN. The sub-NNs are trained to estimate probability distributions of the patient-specific time to SCDA. The performance of this learning architecture was evaluated on multi-center internal validation data (*n= 156*), and tested on an external, independent test set (*n= 113*).
Results: The DL-predicted survival curves offer accurate arrhythmic sudden death predictions at all times up to 10 years and allow for estimation of patient-specific uncertainty in predictions. It achieves concordance index of 0.83 and 0.74, and 10-year integrated Brier score of 0.12 and 0.14, respectively. We additionally demonstrate that our DL approach with only raw cardiac images as input outperforms standard survival models constructed using both non-imaging and imaging clinical covariates.
Conclusion: Brought to clinical practice, this technology has the potential to transform clinical decision-making by offering accurate, generalizable, and interpretable predictions of patient-specific survival probabilities of SCDA over time.