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ARRHYTHMIAS

Arrhythmia risk stratification using virtual heart models

A personalized 3D computer modelling system designed to assess the risk of sudden cardiac death (SCD) in patients with myocardial infarction outperformed currently used clinical metrics for predicting arrhythmic events. This virtual-heart arrhythmia risk predictor (VARP) was described in a proof-of-concept study published in *Nature Communications*.

Although implantable cardioverter–defibrillators (ICDs) have been proven to reduce mortality in patients at high risk of SCD, the current metrics used to identify candidates for ICD therapy are of low sensitivity and specificity, and thus fail to detect the majority of individuals who develop SCD. A novel approach to assess SCD risk based on cardiac imaging and computational modelling has now been described by Natalia Trayanova and colleagues. According to Dr Trayanova (Johns Hopkins University, Baltimore, USA), her research group's goal is to "create a virtual heart for every patient that will enable the physician to play out scenarios that manifest the cardiac dysfunction of that particular patient, and to enable physicians to make personalized and informed decisions about patient treatment".

The first step in creating the VARP involved a 3D reconstruction of patient-specific ventricular wall geometry using contrast-enhanced clinical MRI. Electrophysiological properties were subsequently assigned to different elements in the model, and the virtual heart model was electrically paced from several biventricular locations. A patient was deemed at risk of SCD if arrhythmia was elicited from at least one of the 19 pacing locations (indicating a positive VARP test).

The predictive capacity of the VARP model was assessed retrospectively using data from 41 patients with myocardial infarction and left ventricular ejection fraction (LVEF) <35%. All patients received an ICD, and were followed up for the primary end point of appropriate ICD firing owing to ventricular arrhythmia or cardiac death. The predictive capacity of the VARP was compared with that of LVEF, the main metric used to predict SCD risk in the clinic, as well as that of other metrics such as grey-zone volume, scar volume, and left ventricular mass. VARP was also compared with invasive electrophysiological testing in 32 of the 41 patients.

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A positive VARP test was associated with the primary end point, and patients with a positive VARP test had a fourfold higher risk of arrhythmia than patients with a negative test. Furthermore, comparison of VARP with LVEF and other clinical risk predictors demonstrated that only the VARP outcome was significantly associated with arrhythmic risk. Furthermore, in patients who underwent both VARP and electrophysiological testing, the hazard ratio for VARP was 10.4 (95% CI 1.4–79.0, $P=0.02$) versus 1.7 for electrophysiological testing (95% CI 0.6–4.8, $P=0.35$).

Together, this study demonstrates that the VARP noninvasive approach in predicting arrhythmia risk associated with myocardial infarction is superior to the current clinical metric, LVEF, as well as other noninvasive and invasive predictors. According to Dr Trayanova, "this approach could eliminate many unnecessary ICD implantations and their associated complications (such as infections, device malfunctions, and inappropriate shocks), benefiting innumerable patients. Furthermore, this methodology could also save the lives of patients with preserved LVEF, who could also be at risk of SCD, but are generally not targeted for ICD therapy under current clinical recommendations."

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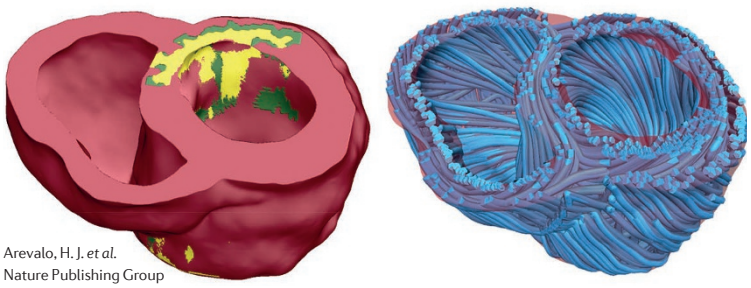

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FURTHER READING Lewis, G. F. & Gold, M. R. Clinical experience with subcutaneous implantable cardioverter-defibrillators. *Nat. Rev. Cardiol.* **12,** 398–405 (2015)