Using Patient-Specific Modeling of the Heart for Risk Stratification for Ventricular Arrhythmia in Patients with Repaired Tetralogy of Fallot (TOF) via Image-Based Computational Simulations

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Technology description

The JHU inventors previous invention (C11304) provides a non-invasive method to identify the optimal ablation sites for infarct-related ventricular tachycardia (VT) by using 3D electrophysiological heart simulations with a model reconstructed from the patient's late gadolinium-enhanced (LGE) MRI image. In this application, the inventors extend that methodology to patients with Tetralogy of Fallot (TOF), the most common form of cyanotic congenital heart disease. TOF hearts are quite unique in terms of their geometry, scar profile, and etiology of arrhythmia. In the TOF cohort, 43% of patients have a sustained arrhythmia or an intervention for an arrhythmia in their lifetime. Roughly 10% of patients with TOF develop high grade ventricular arrhythmia. This degree of pathologic rhythm disturbances is due to scar formation and fibrosis from surgery and years of pulmonary valve disease. Leveraging our previous inventions, we have extended our "virtual heart" methodology based on patient-specific model construction from MRI data to be able to stratify which patients have risk of arrhythmia and may need an ablation, implanted device, or earlier surgical intervention. The ability to predict arrhythmia risk, in the non-invasive way as disclosed here, would be extremely valuable and change the clinical approach to managing patients with repaired TOF. The current clinical practice is to use various methods of risk stratification in an attempt to get a rough composite of what a patient's arrhythmia potential is. These methods are based on surface ECG findings, Holter monitor recordings, clinical events such as syncope, and MRI metrics such as right ventricular volume. All of these measures have yet to provide a reliable method for risk stratification.

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