Combined 3D modelling technique predicts abnormal heart rhythms in patients with genetic heart disease

January 25 2022

Credit: Unsplash/CC0 Public Domain

Modeling the heart in 3D using combined imaging techniques can help predict heart rhythm abnormalities, or arrhythmias, in patients with a

genetic heart disease, shows a study published today in *eLife*.

The technique may one day help clinicians determine which patients with a condition called hypertrophic cardiomyopathy might benefit the most from a defibrillator.

Hypertrophic cardiomyopathy is a disease that causes thickening and scarring in the heart muscles. Some people may not have clear symptoms of the condition, but others may develop heart rhythm abnormalities that can lead to sudden death.

"There are ways to predict which patients are at risk of developing heart arrhythmias and who might benefit from a defibrillator, but these methods are not highly accurate," explains first author Ryan O'Hara, Research Assistant at the Trayanova Lab, Johns Hopkins University, Baltimore, Maryland, US. "We wanted to develop a more accurate and personalized approach for predicting abnormal heart rhythms in patients with hypertrophic cardiomyopathy."

To do this, O'Hara and his colleagues combined two techniques: contrast-enhanced cardiac magnetic resonance imaging with late gadolinium enhancement, and post-contrast T1 mapping. Together, these methods enabled the team to construct digital, personalized replicas of patients' hearts, including specific scarring and thickening characteristics, and to evaluate the likelihood that they would go on to develop heart arrhythmias.

Testing this approach in 26 patients showed that it accurately predicted which patients would develop abnormal heart rhythms approximately 80% of the time. "This is a substantial improvement over currently used prediction techniques, which are only accurate about half of the time," O'Hara says.

Their work also showed that cardiac diffuse fibrosis—lesions that are associated with progression to heart failure, but are rarely assessed in patients with hypertrophic cardiomyopathy—can increase these patients' likelihood of developing an abnormal heart rhythm.

More studies are now needed to confirm if this personalized modeling approach can be used to guide patient care before the technique can be adopted more widely.

"If our technology is shown by larger studies to be superior to existing prediction methods, then it could help ensure that patients at high risk of heart arrhythmia receive a defibrillator or other appropriate intervention," concludes senior author Natalia Trayanova, the Murray B. Sachs Professor of Biomedical Engineering and Medicine at Johns Hopkins University. "Likewise, it could also ensure that patients who are unlikely to benefit are spared the risks of implantation."

More information: Ryan P O'Hara et al, Personalized computational heart models with T1-mapped fibrotic remodeling predict sudden death risk in patients with hypertrophic cardiomyopathy, *eLife* (2022). DOI: 10.7554/eLife.73325

Provided by eLife