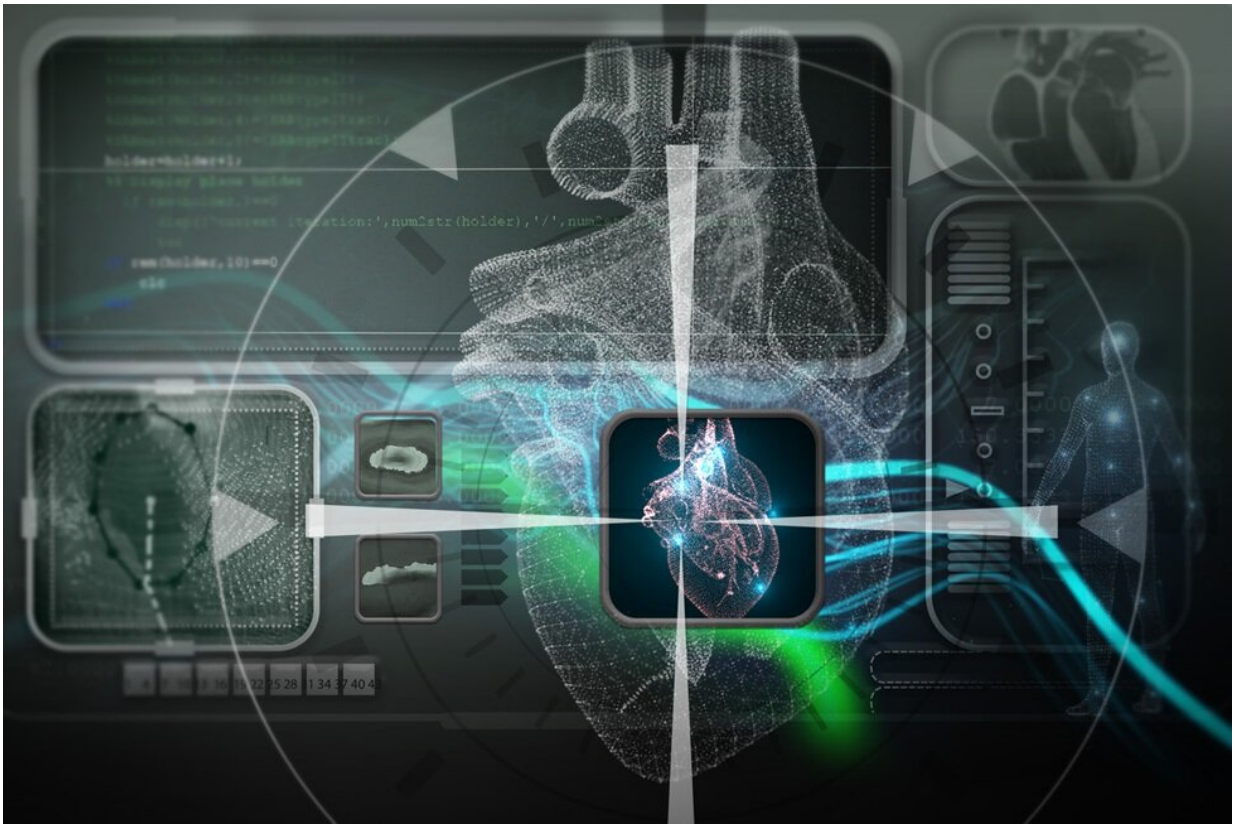
Medical Xpress

Algorithm steers catheters to the right spot to treat atrial fibrillation

May 21 2019



In human atrial fibrillation simulations, this technique stops the catheter at the right target and identifies the source type with a 95.25% success rate and a 99 percent detection rate of scar tissue, regardless of scar size. Credit: Florida Atlantic University

Patients with atrial fibrillation or AFib experience chaotic electrical

signals in the upper chamber of their heart (atria), which cause an irregular or quivering heartbeat (arrhythmia) that can lead to blood clots and heart failure. AFib also is a major cause of stroke and affects 33 million people worldwide.

When medications and other treatments fail, specially trained cardiologists (electrophysiologists) turn to ablation, which involves a catheter that is gently guided to the heart to destroy malfunctioning tissue and scar the problematic areas. Prior to surgery, electrophysiologists require advanced 3-D mapping of the heart to direct them to problematic areas, which is a laborious and time-consuming process.

This procedure also poses a number of challenges for physicians including low, long-term success rates, which requires a need for new techniques to successfully guide catheter movements and accurately detect AFib targets.

Researchers from Florida Atlantic University's College of Engineering and Computer Science and collaborators have developed the first algorithm that can locate patient-specific ablation targets within the atria that does not require specialized catheters or 3-D electro-anatomic maps of the heart. The new algorithm—the iterative catheter navigation (ICAN) - is fundamentally different from existing approaches.

In the study, published in the journal *Cardiovascular Engineering and Technology*, the researchers demonstrate that ICAN stops the catheter when it finds the AFib source and identifies the source type with a success rate of more than 95.25 percent using human Afib simulations.

Researchers also tested the effectiveness of ICAN in the presence of fibrosis and patchy myocardial scars, which makes AFib source detection more challenging, with a 99 percent detection rate regardless

of the scar size, using human Afib simulations.

ICAN iteratively navigates a catheter toward AFib sources, does not involve electrophysiological mapping of the entire surface of the heart, and does not make any assumptions on the AFib source types to navigate the catheter. As a result, this algorithm can be used for locating different types of AFib sources such as rotational circuits and focal beats.

"We have developed the first algorithm to localize atrial fibrillation sources by iteratively navigating a 20-electrode circular catheter that is routinely used for ablation procedures," said Behnaz Ghoraani, Ph.D., senior author, an assistant professor in FAU's Department of Computer and Electrical Engineering and Computer Science, and a fellow of FAU's Institute for Sensing and Embedded Network Systems (I-SENSE) and FAU's Brain Institute (I-BRAIN), two of the university's four research pillars. "ICAN guides the incremental movements of this catheter from an arbitrary initial placement on the atrial tissue until a source of arrhythmia, rotor or focal, is detected by the algorithm."

Ghoraani and collaborators from the Rochester Institute of Technology, the University of Rochester Medical Center, and SUNY Upstate Medical Center, tested ICAN on realistic simulated data with several test cases of rotor and foci-driven arrhythmias, which covered a broad range of activation patterns in 2-D as well as 3-D AFib simulations. They placed the catheter on 114,921 initial catheter locations across the simulated region for different rotor and foci mechanisms. In all cases, they modeled globally distributed fibrosis.

"Professor Ghoraani and her collaborators have developed a cutting-edge technique that has the potential to be a game-changer in how electrophysiologists treat atrial fibrillation with ablation," said Stella Batalama, Ph.D., dean of FAU's College of Engineering and Computer Science. "The high performance of this algorithm is evident by the high

source detection success rate. ICAN could significantly improve the success of patient-specific atrial fibrillation ablation and facilitate treating patients before the disease progresses to the permanent stage."

In addition, the researchers have demonstrated the feasibility of their study in a few human clinical Afib cases and plan to further validate ICAN in more patients. There are currently two patents pending for certain aspects of the algorithm.

Co-authors of the study are Prasanth Gaensan, a graduate student in FAU's College of Engineering and Computer Science; Elizabeth M. Cherry, Ph.D., Rochester Institute of Technology; David T. Huang, M.D., University of Rochester Medical Center; and Arkady M. Pertsov, Ph.D., SUNY Upstate Medical University.

Provided by Florida Atlantic University

Citation: Algorithm steers catheters to the right spot to treat atrial fibrillation (2019, May 21) retrieved 20 September 2024 from
https://medicalxpress.com/news/2019-05-algorithm-catheters-atrial-fibrillation.html