Research will 'revolutionize implantable device therapy'

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(Medical Xpress)—Although an irregular heartbeat is a common malady in the United States, affecting an estimated 5 million people, the treatments for it are limited in scope and effectiveness. Now, Igor Efimov, PhD, at Washington University in St. Louis, is studying a new potential treatment that may be much more effective and less painful for patients.

With a $2.2 million grant from the National Institutes of Health's National Heart, Lung, and Blood Institute, Efimov, the Lucy & Stanley Lopata Distinguished Professor of Biomedical Engineering, and his colleagues are studying low-energy defibrillation, a new treatment that would help to keep the heart rhythm steady with less energy delivered to the heart than traditional implanted defibrillators.

In atrial fibrillation, the heart's electrical system causes an irregular and fast heartbeat. The upper chamber of the heart may beat up to 300 times a minute, or four times faster than normal. While not life-threatening, it can lead to fatigue and a higher risk of stroke. Typically, patients are treated by cardiac ablation, in which a small catheter, inserted into the heart, burns tiny areas of tissue that cause the abnormal electrical signals. Unfortunately, many patients have to return for multiple ablation procedures, often as soon as a year later. Drug treatment is effective in only about 15 percent of patients.

Patients at risk of sudden death due to ventricular fibrillation are typically treated with an implanted defibrillator, which delivers an electric shock, called a biphasic shock, to knock the heart back into rhythm. These shocks are often painful and can cause damage to the heart over time, which limits the use of such biphasic implantable defibrillators in cases of atrial fibrillation.

With the grant funding, Efimov will study delivering multiple shocks to the heart using considerably less energy than the traditional biphasic shock. Instead of one large shock, Efimov and his colleagues will test the use of three stages with decreasing energy levels, called multi-stage electrotherapy.

In a model of persistent atrial fibrillation previously used in his lab, a traditional biphasic shock delivers 165 volts and 1.48 Joules of energy to bring the heart back to a normal rhythm, while the multiphase shock needs only 33.5 volts and 0.16 Joules. Results of this research were published online Sept. 26 in the *Journal of the American College of Cardiology*.

"Based on previous research, most patients feel the shock if it's between 1 to 2 Joules," Efimov says. "We are very encouraged that this shock in the multistage therapy will be below what humans feel."

Using voltage-sensitive imaging, the researchers observed the heart during atrial fibrillation and after the shock was delivered.

"We have developed a technique to visualize the heart from normal and abnormal rhythm using three different projections on the same heart," Efimov says. "Arrhythmia looks like a tornado—it rotates over and over and will continue rotating non-stop."

In the new research, Efimov will work with John Rogers, PhD, the Swanlund Chair and professor of Materials Science and Engineering and director of the F. Seitz Materials Research Laboratory at the University of Illinois at Urbana-Champaign. The team will use materials that have already been approved for implants to make prototypes for high-definition implantable devices—ranging from a tiny, dissolvable device that could be injected into a blood vessel to a vest covered with sensors that stick to the chest—that would be able to monitor many of the body's processes.

"I think it will open a new era in implantable devices," Efimov says. "Because of this development, the next 10 to 15 years will be very exciting, as it will completely change how we can read our bodies with so many parameters. I'm confident that this will revolutionize implantable device therapy."

Provided by Washington University in St. Louis