Secrets of the Heart's Signals

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Natalia Trayanova's research team works on understanding the heart's natural electrical signaling process. The director of the Computational Cardiac Electrophysiology Lab, she is a faculty member in the biomedical engineering department.

The subtle rhythms, pulses and patterns of the human heart have fascinated poets, lovers and scientists alike for millennia, yet the heart's deepest secrets remain tightly locked. Tulane biomechanical engineer Natalia Trayanova and her team may have the most incisive insight into the heart's electrical signals, with a three-dimensional virtual model that demonstrates cardiac activity from cellular to organ level.

Trayanova, director of Tulane's Computational Cardiac Electrophysiology Lab and professor of biomedical engineering, published an article in the March 2006 issue of *Experimental Physiology* describing the model's ability to predict the impact of electric shocks on tissues throughout the heart, a demonstration with implications for the world of heart-disease management.

Her research is dedicated to understanding the heart's natural electrical signaling process and how it interacts with electric shocks delivered by a defibrillator in order to improve the current anti-arrhythmia therapy.

Defibrillators provide an electric pulse that is intended to restore a heart's healthy rhythm. Prior to receiving implantable defibrillators, patients relied on pharmaceuticals with significant and often fatal side effects. Despite the relative improvement represented by current defibrillators, Trayanova says the pulse can cause people pain and discomfort.

In some patients, fear of receiving a pulse at an awkward moment, such as while driving, leads to additional anxiety. Correcting the problem is an issue of pulse energy and timing in relationship to the individual heart.

"Implanted defibrillators are a bit like using heavy explosives to open a door because you don't have the key. We are looking for the key," says Trayanova. "Our goal here is a more effective defibrillator. Over the past decades, defibrillators have become smaller and their batteries last longer but nothing has changed much in terms of the actual mechanisms as far as affecting the electrical activity of the heart."

Trayanova's current model is based on a healthy rabbit heart. Although small, rabbit hearts are very similar in structure to human hearts.

"We have one of the most advanced cardiac models out there," Trayanova explains, adding that her team has already modeled the behavior of ischemic rabbit hearts and are hoping to move on to the impact of infarction. Because defibrillators are not always implanted in healthy hearts, Trayanova's team must also understand the way in which diseased hearts respond.

Source: Tulane University

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