Concurrent imaging of metabolic and electric signals in the heart

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Cardiac rhythm disorders can result from disturbances in cardiac metabolism. These metabolic changes are tightly linked with specific cardiac electrophysiology (CEP) abnormalities, such as depressed excitability, impaired intra- and extracellular conductivities, wave propagation block, and alteration of conduction velocity, action potential amplitude, and duration. The altered electrophysiology eventually can lead to arrhythmias, fibrillation, and cardiac death; therefore, understanding the spatiotemporal complexity of the relationship between metabolism and electrophysiology is the challenge in developing new approaches for treatment of cardiac diseases.

The optical system for simultaneous imaging electrical and metabolic quantities in the heart was developed by scientists at Vanderbilt University. The advantages of their imaging system over others include an optional software camera calibration routine that eliminates the need for precise camera alignment. The system allows for rapid setup, dichroic image separation, dual-rate imaging, and high spatial resolution, and it is generally applicable to any two-camera measurement.

The authors provide a detailed description of a camera calibration algorithm along with multiple examples. They demonstrate the capabilities of this type of imaging system for recording not only the transmembrane potential and intracellular calcium, but other signals more directly related to myocardial metabolism, such as [K+]e, NADH, and reactive oxygen species, leading to the possibility of correlative multimodal cardiac imaging. The authors findings appear in the

November issue of *Experimental Biology and Medicine*.

"The challenge in understanding cardiac rhythm disorders is to discern the dynamic relationship between multiple cardiac variables," John Wikswo notes. "This dual camera system opens up a new window for correlating metabolic and electrophysiological events, usually studied independently."

Veniamin Sidorov expects that "the measurement of multiple cardiac parameters during cardiac ischemia or hyperkalemia may enable the screening of new drugs that can be used to adjust electrical and contractile activities of the heart more precisely than commonly used ion-channel blockers/activators."

In summary, the development of metabolic therapies for CEP abnormalities requires simultaneous observation of CEP and metabolism, and a mechanistic understanding of their relationship. The authors' analysis of the potential for dual camera systems and implementations advances the understanding of "electrometabolic" cardiac disorders and their clinical treatment, and their review of related efforts to extend the optical measurements of myocardial function suggests that this is a field worthy of expanded research.

Steven R. Goodman, Editor-in-Chief of *Experimental Biology and Medicine* said "This technological advance allows the simultaneous measurement of changes in the electrical properties and metabolic profile of the same region of the heart. The ability to measure these coupled phenomena will improve our mechanistic understanding of various cardiac abnormalities including heart failure, fatal arrhythmias, and rate-dependent cardiac remodeling."

Source: Society for Experimental Biology and Medicine (news : web)