**ABSTRACT**

Current rescue therapies for life-threatening arrhythmias ignore the pathological electrophysiological substrate and base their efficacy on a generalized electrical discharge. Here, we developed an optovolt platform to examine less invasive defibrillation strategies. A strabismus-field microscope was developed to optically map action potential propagation with a multimodal voltage sensitive dye in whole mouse hearts. The macroscope was implemented with a random-access scanning head capable of drawing arbitrary-shown stimulation patterns with submillisecond temporal resolution allowing precise epipolar activation of Channelrhodopsin2 (CH2D28). We employed this optical system in the setting of ventricular tachycardia to optimize mechanistic-based, multi-barrier defibrillation patterns. Multiple regions of conduction block were created with a very high cardioversion efficiency but with lower energy requirements as compared to whole ventricular interventions to interrupt arrhythmias. This work demonstrates that defibrillation patterns can be substantially reduced by applying discrete stimulation patterns and promotes the progress of current anti-arrhythmic strategies.

*Simultaneous all-optical map and control of cardiac electrical activity in mouse whole hearts*.

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**Optogenetics Design of Mechanistic-Based Stimulation Patterns for Cardiac Defibrillation**

**Characterization of Cardiac Response to ChR2 Activation**

**Customized Pattern Design for Interruption of Ventricular Tachycardia**

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**습관적인 패턴 디자인에 의한 전구형 탕마혈관의 중단**