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Low Energy Defibrillation by Synchronization; 90 % less energy compared to one shock.

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By establishing a relationship between the response of cardiac tissue to an electric field and the spatial distribution of heterogeneities due to the coronary vascular structure, it is possible to show that these heterogeneities serve as nucleation sites for the generation of intramural electrical waves with density $\rho(E)$ in response to a pulsed electric field of strength E. By using this relationship it is possible to entrain fibrillatory cardiac tissue to a given pacing frequency by synchronization thus terminating the spatiotemporal complex dynamics and restoring the tissue to a normal rhythm. We demonstrate this mechanism first mathematically and then in vitro using voltage optical mapping in atrial and ventricular tissue. We show that the energy required per pulse is about 10% the energy required for a defibrillation shock.