Abstract

A steerable intracardiac echocardiography (ICE) and pulsed-field ablation (PFA) fusion catheter is disclosed. The catheter integrates an ultrasound imaging transducer with a multi-electrode pulsed-field ablation assembly on a single flexible shaft. This allows real-time intracardiac imaging and non-thermal cardiac ablation to be performed sequentially or simultaneously. The integrated design enables precise guidance and monitoring of ablation lesions during procedures (e.g., atrial fibrillation pulmonary vein isolation) without the need for a separate imaging catheter. Key features include an energy-isolated signal chain to prevent high-voltage PFA pulse interference with ultrasound imaging, a bidirectionally deflectable shaft for steering within the heart, and optional irrigation channels for cooling PFA electrodes. Use-case examples include delivering PFA lesions near sensitive structures (esophagus, phrenic nerve) under direct ICE visualization for enhanced safety. The specification provides details of construction (e.g., multi-lumen shaft, phased-array or mechanical ICE transducers, expandable electrode deployments) and multiple embodiments. Broad claim coverage is presented for the system, methods of use, and modular components, anticipating international patent requirements.