

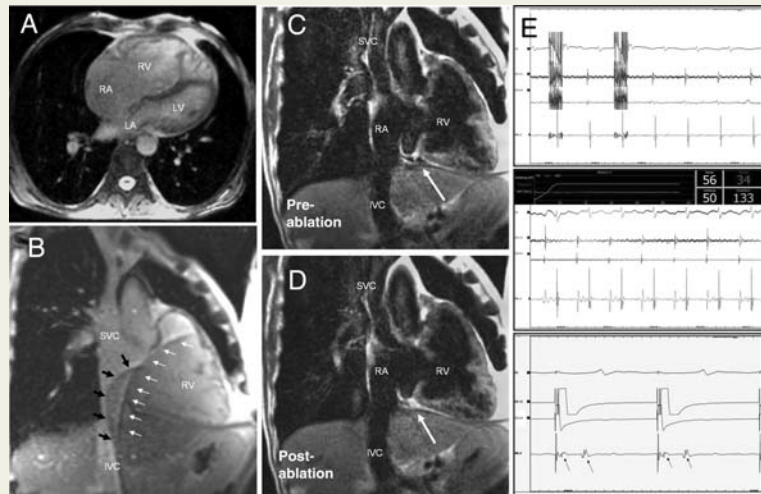
CARDIOVASCULAR FLASHLIGHT

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Cardiac catheter ablation under real-time magnetic resonance guidance

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One of the main shortcomings of interventional electrophysiology (EP) is its inability to generate sufficient soft tissue contrast for intra-procedural visualization of the myocardium and the surrounding tissue, using conventional imaging techniques. Interventional cardiovascular magnetic resonance imaging (MRI) aims at bringing about significant improvements to the complex and decisive EP interventions far beyond the capabilities of currently available supportive imaging techniques used to surmount the drawbacks of fluoroscopy, as MRI not only allows of precise three-dimensional exposure of the cardiovascular morphology, but also proves to be a promising technique exclusively suitable for direct visualization of arrhythmogenic substrate and therapeutic effects. The major challenge posed by clinical adoption of



MR-guided EP interventions is the development of a set-up that overcomes the large number of technical problems caused by the interference of the EP set-up with the MRI environment. Late decisive improvements of an interventional MR-EP setup just recently enabled accomplishment of initial clinical applications in our hospital using this new technique. The figure illustrates the successful treatment of the first patient with arrhythmia after two failed approaches of conventional catheter ablation therapy using catheter ablation under real-time MRI guidance. This patient suffered from congestive heart failure due to pulmonary hypertension with repeated pulmonary embolism resulting in a highly dilated right ventricle (Panel A). His clinical condition dramatically worsened because of atrial flutter, but medical therapy was inefficient and catheter ablation failed to restore sinus rhythm, presumably because of pronounced right ventricular and atrial hypertrophy. The patient was referred to the MRI for real-time MR-guided ablation therapy. The intervention was performed in total in the MR scanner room (1.5 T MRI, Siemens, Germany) without using fluoroscopy. Intra-cardiac catheter guidance and mapping in the right atrium and ventricle with the custom, irrigated catheters (VascoMed/Biotronik, Germany) specially designed for use in the MRI is shown in Panel B and in Supplementary material online, Video S1. Panels C and D illustrate real-time monitoring of lesion formation during the procedure, with T2-weighted imaging used to confirm transmuralty of the lesions after ablation (arrow, Panel D). Surface ECG and IEGMs acquired by a Cardio Lab EP console with custom filters during MR-guided mapping, ablation, and after successful completion of isthmus blockade are shown in Panel E.

In this patient, catheter ablation under real-time MRI guidance could be successfully carried out as a new technique to treat arrhythmia after two failed approaches of conventional catheter ablation. Combination of advanced imaging techniques for simultaneous tissue and catheter visualization, monitoring of ablation, and assessment of the ablation lesions may be potential advantages over conventional EP in the future. Further technical and procedural improvements are warranted, which would concurrently widen the range of applications and assure patient safety, in order to bring this technique to broader clinical practice.

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