Catheter Ablation for Ventricular Tachycardia in Patients with Nonischemic Cardiomyopathy

Nathaniel Thompson, MD*, Antonio Frontera, MD, Masateru Takigawa, MD, Ghassen Cheniti, MD, Gregoire Massoullie, MD, Hubert Cochet, MD, PhD, Arnaud Denis, MD, Arnaud Chaumeil, MD, Nicolas Derval, MD, Meleze Hocini, MD, Michel Haissaguerre, MD, Pierre Jais, MD, Frederic Sacher, MD, PhD

KEYWORDS

• Ventricular tachycardia • Ablation • Nonischemic cardiomyopathy

KEY POINTS

- Nonischemic cardiomyopathy (NICM) is an umbrella term for a mixed group of disease processes that often involve the intramyocardium and epicardium.
- Cardiac MRI is a powerful tool that can identify substrate involvement (and sites critical to the maintenance of ventricular tachycardia [VT]), which is sometimes not possible with conventional mapping.
- Clinicians should consider cardiac MRI in all patients with NICM before an implantable cardioverter-defibrillator or device implant in anticipation of future VT.
- Alternative technologies can create deeper lesions than conventional catheter ablation techniques and are valuable options for clinicians, particularly when targeting the interventricular septum or the midmyocardium.

Catheter ablation of ventricular tachycardia (VT) has become an increasingly performed procedure. Studies have shown that ablation can reduce episodes of VT in patients with ischemic heart disease (and likely scar-mediated tachycardia).[1,2] The number of patients with nonischemic cardiomyopathy (NICM) requiring VT ablation has increased in proportion.[3] However, in those patients with NICM, the results have been more mixed,[4] and generally inferior when compared

Disclosures: Dr A. Denis received speaking honoraria from Medtronic and Boston Scientific. Dr N. Derval received speaking honoraria from Medtronic, Boston Scientific, and Biosense Webster. Dr M. Haissaguerre received consulting fees from Biosense Webster and is a stock holder of Cardio Insight. Dr M. Hocini received consulting fees from Medtronic and Biosense Webster and is a stock holder of Cardio Insight. Dr P. Jais received consulting fees from Biosense Webster, Boston Scientific, St. Jude Medical and is a stock holder of Cardio Insight. Dr F. Sacher received speaking honoraria from Biosense Webster, Medtronic, St. Jude Medical, Sorin Group, Boehringer Ingelheim, Bayer HealthCare, Pfizer, and Buchang Pharma; consulting fees from St. Jude Medical, Bayer Healthcare, and the Sorin Group; and a research grant from Medtronic.
Bordeaux University Hospital, LIRYC Institute, INSERM 1045, Bordeaux University, France
* Corresponding author. Hopital Haut-Leveque, Av. Magellan, Pessac 33600, France.
E-mail address: n.clark.thompson@gmail.com

Card Electrophysiol Clin ■ (2016) ■–■
http://dx.doi.org/10.1016/j.ccep.2016.10.003
1877-9182/16/

with patients with ischemic cardiomyopathy (ICM). That patients with NICM fared worse may be explained by the variety and extent of the disease processes (including epicardial and intramural involvement) as well as the ablation strategies used.[5] What is required for the best chance of procedural success is a careful diagnosis of the arrhythmia mechanism and the substrate necessary for its maintenance.

PREPROCEDURE ASSESSMENT

Before the procedure it is important to try to localize the VT and identify regions of substrate involvement (septal vs lateral, periannular, endocardial vs epicardial and intramural). The electrocardiogram can identify epicardial tachycardias[6,7] and can provide other clues during a normal rhythm (eg, arrhythmogenic right ventricular cardiomyopathy [ARVC], sarcoidosis, laminopathy). Acquiring an echocardiogram is standard and provides information on valvular function and overall ventricular function, and can rule out thrombus (a contraindication to endocardial mapping). Preprocedural imaging with computed tomography (CT) and cardiac MRI is particularly helpful. Cardiac MRI with delayed enhancement can help diagnose infiltrative processes such as ARVC and sarcoidosis, and can more generally localize regions of fibrosis or scar (**Fig. 1**).[8] This ability is useful in crafting an ablation strategy (whether to approach epicardially or endocardially) or if other techniques, such as septal or transcoronary alcohol ablation techniques, should be considered. Reconstructed images of both CT and MRI can be imported into three-dimensional mapping systems; overlaid images can guide mapping and ablation of critical regions and also avoid important structures (eg, coronary arteries) (**Fig. 2**). In anticipation of future requirements for VT ablation, the authors perform cardiac MRI in all patients with NICM referred for implantable cardioverter-defibrillator or device implantation.

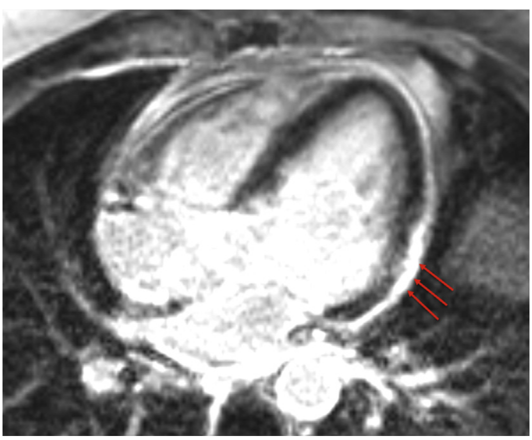

Fig. 1. An example of cardiac MRI with delayed enhancement identifying subepicardial scar in the lateral left ventricle (*red arrows*) in a patient with postmyocarditis VT. Endocardium is preserved without wall thinning. Endocardial ablation in this patient has little chance to be successful.

PROCEDURE AND MAPPING STRATEGIES

Initial choice of catheter access is guided by the preablation work-up. The left ventricle (LV) can be accessed retrograde across the aortic valve, antegrade with a transseptal puncture, and from an epicardial approach. Similarly, the right ventricle (RV) can be accessed from the endocardium or from the epicardium. The transseptal approach is effective to reach most of the left ventricular endocardium, although it requires the use of a large, curved, steerable sheath to maneuver easily. It is more difficult to access the basal septum and aortic outflow tract. The retrograde aortic approach is more effective in these scenarios.

The authors recommend diagnostic catheters placed in the His position (useful to diagnose bundle branch reentry and as a landmark during the transseptal puncture) and another to make electrogram recordings from the RV, or from the LV via the coronary sinus. Ventricular capture thresholds should be tested at the beginning of the procedure to be ready for entrainment or pace termination of the clinical tachycardia. High-resolution mapping catheters with multiple electrodes, such as the Livewire (St. Jude Medical, Saint Paul, MN), Orion mapping catheter (Boston Scientific, Marlborough, MA), and the Pentaray mapping catheter (Biosense Webster, Diamond Bar, CA), can rapidly acquire points and are better able to resolve near-field from far-field ventricular signals than more conventional mapping catheters. Their maneuverability in the pericardial space is generally not a problem. However, it may be more challenging to map the endocardium and negotiate the left ventricular space, particularly when the ventricles are not dilated.

To safely arrive at the proper diagnosis and treatment plan, the authors try to be systematic in the use of maneuvers (**Table 1**). After gaining arterial and venous access and diagnostic catheters are in place (and before full anticoagulation), we proceed with pericardial access if there is evidence of epicardial involvement.[9] We then create a map of the epicardial substrate and tag local abnormal ventricular activity potentials. Afterward, we access the left ventricular endocardium via a