EMERGING TECHNIQUES

Successful Radiofrequency Catheter Ablation of Parahisian Ventricular Tachycardia using Remote Magnetic Navigation and an Open Irrigation Catheter: An Initial Case Series

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ABSTRACT. Radiofrequency catheter ablation (RFCA) of ventricular tachycardia (VT) found to be in a parahisian (PH) location may be challenging when using a manual technique. We present an initial case series illustrating the safety and efficacy of RFCA of PH VT using remote magnetic navigation (RMN) and an open irrigation catheter (OIC). Conventional electrophysiology study (EPS) with baseline cardiac intervals was performed. A RMT OIC (Biosense Webster) was used for stereotactic mapping and ablation. The His bundle was identified and tagged for reference on the ablation map. Pace mapping (PM) with correlation to template VT was performed to identify the area of VT origin. RFCA was performed in power control mode at 40 W for 30-s lesions. Both patients received radiofrequency ablation of VT in a PH location without significant prolongation of AH or HV intervals, or signs of heart block. There was no recurrence of template VT in either patient. The use of RMN and an OIC is safe and effective for ablation of VT in a PH location. RMN allows greater catheter manipulation and stability. The OIC permits higher ablation powers.

KEYWORDS. radiofrequency ablation, remote magnetic navigation, ventricular tachycardia.

Introduction

Radiofrequency catheter ablation (RFCA) of ventricular tachyarrhythmias represents a useful tool in the long-term management of patients with implantable cardioverter-defibrillators (ICDs). Patients with medically refractory ventricular tachycardia (VT) often require invasive treatment of recurrent symptomatic VT; hence, the growing numbers of procedures performed worldwide to palliate the burden of these arrhythmias. RF is the most common energy source used during the ablation of VT. Recent reports have described the utility of cryoablation of VT in ventricular territories located near the His bundle. While cryoenergy delivery may be advantageous in such situations, we report the initial series describing the use of remote magnetic navigation (RMN) coupled with an open irrigation RF ablation catheter (OIC) to treat VT originating near the His bundle with an excellent safety and efficacy profile.

Case 1

A 50-year-old man with a history of non-ischemic cardiomyopathy (NICM) due to viral myocarditis and
paroxysmal atrial fibrillation presented with recurrent monomorphic VT prompting appropriate ICD therapies. The left ventricular ejection fraction (LVEF) measured 35%. Medications included a β-blocker, angiotensin-converting enzyme inhibitor, and dofetilide for AF suppression. Transitioning from dofetilide to amiodarone versus catheter ablation for the treatment of VT was presented to the patient, who opted to undergo an ablation procedure. Electrophysiology (EP) testing was performed in the conventional fashion under general anesthesia administered by anesthesiology. Venous and arterial access was obtained. Diagnostic catheters were positioned in the right ventricle (RV), coronary sinus (CS), and the His bundle territory. Monomorphic VT was induced with programmed electrical stimulation (PES) demonstrating a cycle length of 282 ms. VT demonstrated an inferiorly directed axis (Figure 1). Owing to hemodynamic instability during VT, it was pace terminated. Via a transseptal route, we stereotactically mapped an area of scar confined to the subaortic annular territory extending inferiorly toward the septum using the Carto®3 three-dimensional mapping system (Biosense Webster, Diamond Bar, CA). Both late and split diastolic potentials were noted in this region. However, pace mapping in this territory did not yield close correlation with template VT. Consequently, the catheter and sheath were repositioned into the right ventricle. Pace mapping on the RV aspect of the interventricular septum yielded a nearly perfect pace map correlate in the mid-septal location in an immediate parahisian (PH) location. RF application was performed here at 35–40 W with an open irrigation RMT ThermoCool™ catheter (Figure 2). With repeat PES, a second VT was induced emanating from the left ventricular outflow tract (LVOT). This VT demonstrated a similar morphology as template VT with an earlier transition to positivity in the precordial leads. RV activation during VT was late, so we mapped the LVOT near this His bundle region immediately inferior to the aortic valve. RF application here resulted in termination of VT. Further attempts at VT induction were unsuccessful.

Case 2
A 59-year-old man with a history of ischemic cardiomyopathy (ICM) and coronary heart disease was referred to our center for evaluation for possible ablation of recurrent medically refractory VT prompting appropriate ICD therapies (Figure 3). He had previously undergone catheter ablation of VT at another facility 3 years prior. Despite chronic amiodarone use, he experienced recurrent symptomatic VT resulting in ICD therapies. Dual anti-arrhythmic medical therapy versus catheter ablation was discussed with the patient, who subsequently elected to proceed with a repeat catheter ablation procedure. EP testing was performed in the conventional fashion under general anesthesia. Catheters were positioned in

Figure 1: Twelve-lead electrocardiogram of template ventricular tachycardia obtained during electrophysiology testing.
the His bundle region as well as the RV apex and CS. PES from the RV was unsuccessful for induction of VT. Owing to his previously incessant nature of VT, the decision was made to pace map tachycardia using prior 12-lead electrocardiograms as a template. Transseptal puncture was performed in the conventional fashion. Three-dimensional voltage mapping of the LV using the Carto®3 mapping system defined territories of scarring. Pace mapping of the LV yielded a 12/12 pace map correlate of template VT in an immediate PH territory on the LV aspect of the interventricular septum. Diastolic potentials were noted in this territory as well. Utilizing the open irrigation RMN catheter, we performed RF application at 40 W (Figure 4). Occasional junctional beats were noted during RF application, but no prolongation of the AH or HV intervals occurred. Further attempts at VT reinduction were unsuccessful.

Figure 2: Bipolar voltage map created with Carto®3 RMT mapping system. A right lateral view demonstrates both right ventricular and left ventricular lesion sets adjacent to the His bundle territory.

Discussion

RMN and RFCA of VT

Recent reports have highlighted the efficacy and safety profile of RMN using an OIC to treat VT in a variety of cardiomyopathic populations.3–5 Specifically, RMN has yielded comparable (and in some instances superior) results when compared with manual ablation in the ischemic and non-ischemic VT populations. Features of RMN making it attractive for these procedures include lesion depth, precision, and catheter flexibility allowing for ablation in regions of both ventricles historically difficult to navigate manually during RFCA. Maneuverability of the RMN catheter tip enables vertical alignment with the endocardium facilitating deeper lesion creation. Specifically, horizontal catheter tip positioning has been associated with volumetrically smaller lesion creation than vertical alignment.6

RMN and PH VT ablation

RMN RFCA in a PH location during the ablation of VT has not been previously described in the cardiomyopathy population. Numerous cases have been reported of successful manual RFCA of premature ventricular contractions (PVC) emanating from the PH region in patients with structurally normal hearts.7,8 The cardiomyopathy population presents several unique mapping and ablation challenges including dilated valvular annuli, structural remodeling and dilatation of the ventricles, and low amplitude electrograms owing to myocardial scarring. As demonstrated in Case 1, ablation from both aspects of the interventricular septum may be necessary for septal VT eradication in these populations (Figure 2).
Figure 3: Twelve-lead electrocardiogram of template clinical ventricular tachycardia obtained pre-ablation.

Figure 4: Bipolar voltage map created with Carto™3 RMT mapping system. A right lateral view demonstrates sites of successful pace-mapping-guided ablation lesion delivery.
Recent attention has focused on the use of cryoenergy in the PH region owing to its safety profile and catheter adherence to the endocardium during cryoablation. However, cryoenergy has limited data available in the treatment of VT in the setting of underlying structural heart disease. Cryoenergy, while precise once cryoadherence has occurred, still relies upon manual navigation in a small region with a larger tipped catheter. Additionally, lesion delivery with cryoenergy takes longer than with RFCA, adding to procedural duration. RMN offers the benefit of catheter stability coupled with the use of RF energy within the ventricle. The PH territory by definition is peri-annular, and annular excursion may present challenges to manual catheter stability when ablating in this region. In our cases, we demonstrate that catheter stability with the RMN system was maintained both during VT and sinus rhythm. We observed no evidence of AH, HV, or PR interval prolongations either during or following RF application. At 12-month follow-up, each patient has remained free of template VT and ICD therapies.

Conclusions
RMN-guided RFCA in the PH region appears safe and effective for the treatment of PH VT in patients with underlying structural heart disease. This technique offers the combined benefit of precise application of RF lesions using the RMN guided OIC.

References