Bipolar Ablation of Ventricular Tachycardia in a Patient After Atrial Switch Operation for Dextro-Transposition of the Great Arteries

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A 39-year-old man with atrial switch repair (Mustard baffle) and transpulmonary resection of infundibular muscle for dextro-transposition of the great arteries and subpulmonary stenosis was referred for ablation of a drug-refractory monomorphic ventricular tachycardia (VT). Before the ablation, the patient underwent multidetector CT to detect anomalous coronary anatomy (Figure 1A–1C) and contrast-enhanced MRI (CE-MRI) to determine the extent of scar after surgical resection. CE-MRI showed late enhancement in the basal interventricular septum extending toward aortic sinus 2 (origin of the circumflex artery) (Figure 1D and 1E). During the ablation procedure, both multidetector CT and CE-MRI-derived images were integrated with the electroanatomical maps. VT was induced, and diastolic activity could be recorded at the aortic sinus 2 and at the opposing site in the right ventricle (RV). There was no capture when high-output pacing at these sites was performed to entrain the VT. Irrigated-tip radiofrequency (RF) delivery resulted in slowing of the VT when applied from the aortic sinus site (up to 40 W; flow rate, 20 mL/min) and consecutive late termination when RF was delivered from the RV site (up to 50 W; flow rate, 30 mL/min).

After the procedure, the ablation points were projected onto a CE-MRI-derived scar reconstruction, which revealed an RV subendocardial dense scar rim that may have prevented creation of an effective lesion (Figure 1D and 1E). The patient was discharged on disopyramide after receiving an implantable cardioverter-defibrillator. He was readmitted after 3 weeks with drug-refractory monomorphic VT. Before the ablation, the patient underwent multidetector CT to detect anomalous coronary anatomy (Figure 1A–1C) and contrast-enhanced MRI (CE-MRI) to determine the extent of scar after surgical resection. CE-MRI showed late enhancement in the basal interventricular septum perhaps related to prior surgery. We previously demonstrated that scars, patch material, and valves serve as reentry circuit boundaries in the abnormal heart and provided important complementary information on the VT substrate. In addition, the distance from the catheter in the basal ventricle and the ostium of the circumflex artery measured on the integrated multidetector CT was 20 mm, which was confirmed by angiography (Figure 3A and 3D). RF energy was delivered between the 2 catheters (45 W; flow rate for both, 20 mL/min), resulting in slowing and VT termination after 3 s. VT was no longer inducible. Angiography and detailed echocardiography performed after the procedure showed no damage to the coronary arteries or the aortic valve. The patient was discharged without antiarrhythmic drugs and has remained free of VT 3 months postdischarge.

In patients with atrial switch operations for dextro-transposition of the great arteries, only 1 case of VT ablation has been described in which the VT isthmus was likely located between the aortic annulus and the ventricular septum defect patch. In the present case, the presumed reentry circuit isthmus was most likely bordered by aortic sinus 2 (origin of the circumflex artery) and a scar in the basal interventricular septum perhaps related to prior surgery. We previously demonstrated that scars, patch material, and valves serve as reentry circuit boundaries in patients with corrected tetralogy of Fallot. The present case and the one reported by Nair et al suggest that these findings may also apply to patients with complex corrected dextro-transposition of the great arteries.

In the present case, integrated multidetector CT and CE-MRI-derived images facilitated catheter maneuvering in the abnormal heart and provided important complementary information on the VT substrate. In addition, the distance from the ablation site to the coronary artery ostia could be accurately assessed after image integration.
VT could not be abolished using conventional irrigated-tip RF catheter ablation (RFCA). However, the drug-refractory electrical storm, the visualization of the anatomic isthmus, the scar distribution, and a confirmed safe distance to the coronary arteries justified bipolar irrigated-tip RFCA. This approach proved successful without complications, in particular, no aortic valve damage or thromboembolic event.

The power setting of 45 W during bipolar ablation was based on a prior study in sheep, demonstrating the safety and efficacy of bipolar ablation at 50 W across the interventricular septum.3 There are only limited data on bipolar catheter ablation in humans. In one case report, idiopathic VT originating from the area between the left coronary cusp and the basal left ventricle could not be abolished using conventional unipolar nonirrigated-tip RFCA.4 Bipolar nonirrigated-tip RFCA resulted in successful ablation without complication. This procedure was performed before the widespread use of irrigated-tip catheters and might have been successful with unipolar irrigated RF application. Similarly, in a report by Bashir et al,5 8 patients with posteroseptal accessory pathway that could not be abolished with unipolar nonirrigated-tip RFCA were successfully treated with bipolar nonirrigated-tip RFCA applied between the mitral and aortic sinuses.

Figure 1. MDCT and CE-MRI images. A, The RV is connected to the AO. The LAD and the RCA have a common ostium in sinus 1, whereas the CX has a separate ostium in sinus 2. B, The PVs are connected to the RA, and the VCS to the Mustard baffle, directing blood to the LV. C, The poststenotic dilation of the PT is clearly visible. The infundibular septum is indicated by white arrowheads. D and E, The 3D reconstruction of the CE-MRI-derived scar, with red indicating core scar and yellow, border zone scar. Note the potential anatomic isthmus bordered by aortic sinus 2 and a scar in the basal ventricle. The black tags on either side of the isthmus indicate the ablation points from the aortic sinus 2 and the basal RV that were superimposed on the 3D reconstruction after the procedure. F, The mapping system format that was available during the procedure (purple, >90% scar transmurality; orange, 50%–90% transmurality; green, 1%–50% transmurality). AO indicates aorta; CS, coronary sinus; CE-MRI, contrast-enhanced MRI; CX, circumflex coronary artery; LAD, left anterior descending coronary artery; LV, left ventricle; MDCT, multi-detector CT; PT, pulmonary trunk; PV, pulmonary vein; RA, right atrium; RCA, right coronary artery; RV, right ventricle; VCS, vena cava superior.

Figure 2. Twelve-lead ECG and entrainment mapping in aortic sinus 2. Activation maps of the aortic root and RV registered with multi-detector CT images in a modified posterior view as in Figure 1B, 1C, 1E, and 1F. Diastolic potentials were recorded from aortic sinus 2 and on the opposing site in the RV. At both sides, pacing at high output for entrainment mapping did not capture. Pacing at adjacent sites in aortic sinus 2 with a local electrogram recorded just before QRS onset (large arrow) and in the RV resulted in entrainment with fusion (note the subtle differences in leads III, aVF, V5, and V6) and postpacing intervals equal to the tachycardia cycle length. These findings are consistent with a site close to the exit. AO indicates aorta; CX, circumflex coronary artery; LV, left ventricle; PT, pulmonary trunk; RCA, right coronary artery; RV, right ventricle.
the tricuspid annulus. Only 1 procedure-related pericarditis was reported. Although the present case further supports the safety of bipolar ablation if irrigated-tip catheters are used, the number of cases are limited; therefore, caution is still warranted when considering bipolar RFCA.

In conclusion, we present a case of successful VT ablation in a patient with corrected dextro-transposition of the great arteries with a critical reentry circuit isthmus bordered by the aortic sinus 2 and scar in the basal RV. The case illustrates the importance of scars for monomorphic VT in patients with complex congenital heart disease and the high value of multimodality image integration, particularly in patients with morphologically abnormal hearts. Importantly, bipolar irrigated-tip RFCA was shown to be safe and effective across the aortic valve.

Disclosures

None.

References


**Key Words:** ablation ■ tachycardia ventricular ■ heart defects congenital
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