Ventricular arrhythmias in arrhythmogenic right ventricular dysplasia/cardio-myopathy (ARVD/C) are precipitated by an increase in sympathetic activity, typically physical exercise. As such, β-blockade is the cornerstone of medical treatment. However, some patients are either intolerant or refractory to β-blockers, and many continue to have arrhythmias despite catheter ablation. This report presents the case of an ARVD/C patient with severe ventricular arrhythmias refractory to β-blockade, antiarrhythmic drugs, and 3 endocardial/epicardial ventricular tachycardia (VT) ablations, who was successfully treated with bilateral sympathectomy.

A previously healthy 16-year-old male triathlete presented with a sudden cardiac arrest while swimming. He was diagnosed with ARVD/C based on T-wave inversions V1–V4, 7216 premature ventricular complexes on 24-hour Holter monitoring, left bundle inferior axis VT, and tricuspid dyskinesia with right ventricular ejection fraction 33% (Figure 1). Genetic testing revealed no pathogenic mutation in a 76-gene cardiomyopathy panel (including all 5 desmosomal genes), and he had no familial history of disease. He received a single-chamber implantable cardioverter–defibrillator (ICD) and was discharged on metoprolol. Five months after discharge, the patient received his first shock for VT at 233 beats per minute while dancing. He underwent an endocardial/epicardial VT ablation (Figure 2) and was noninducible at the end of the procedure during random stimulation with and without isoproterenol. He was discharged on long-acting metoprolol. Flecainide was added when palpitations recurred soon after discharge. Five months later, he experienced a VT storm requiring 43 ICD shocks after climbing stairs. He received cardiopulmonary resuscitation and regained consciousness 2 days later. He underwent a second endocardial/epicardial ablation. A stress test before discharge was normal. Amiodarone was initiated for further arrhythmia control. VT recurred 6 months later when he received 8 appropriate ICD shocks while run-
levels have significantly decreased, and he remains free of ICD therapy (Figure 4).

Involvement of the sympathetic nervous system in ARVD/C has been suspected since the first reports of the disease.\textsuperscript{1} The right ventricle and the proximal pulmonary artery are richly innervated by sympathetic nerves from the ventromedial cardiac nerves. High-frequency stimulation in the pulmonary artery induces PVCs from the right ventricular outflow tract, and these nerves have been implicated in the pathophysiology of idiopathic VT. Indeed, the VTs in our patient exhibit features suggestive of catecholamine-mediated focal VT. VTs were easily inducible by minimal exercise and isoproterenol infusion, had fast cycle lengths, and VT salvos on electrophysiology study had similar morphology but different cycle lengths, favoring a triggered over reentrant mechanism. Of note, every previous ablation in this patient had been successful, and exercise stress testing and noninvasive programmed stimulation were normal after 2 of 3 ablation procedures. This questions the role of these tests in the setting of catecholamine-sensitive recurrent arrhythmias. The success of bilateral sympathectomy in controlling arrhythmias in our patient after 3 previous endocardial/epicardial ablations reveals that sympathectomy may achieve arrhythmia control after all other treatment options have been exhausted. Because bilateral sympathectomy involves the removal of postganglionic soma, intramyocardial sympathetic neural regeneration does not occur, leading to a durable antiarrhythmic effect. Unilateral sympathectomy may be less effective in the long-term, as remodeling may occur in the contralateral ganglion,\textsuperscript{2} and may include sprouting within the heart. Furthermore, left and right sympathetic nerves have been demonstrated to innervate unique regions of the heart, with overlap.\textsuperscript{3} As such, implementation of this technique early in the disease course may prevent recurrent VT storms and incapacitating psychosocial symptoms associated with ICD shocks. Although this does not eliminate the need for an ICD, it may result in lower arrhythmia burden, lower medication dependence, and increased quality of life. Future studies in a large number of patients should confirm the role of cardiac sympathectomy in ARVD/C and investigate its optimal timing and use in ARVD/C management.

Disclosures

None.

References


KEY WORDS: ablation \hspace{1em} arrhythmogenic right ventricular dysplasia-cardiomyopathy \hspace{1em} sympathetic nervous system \hspace{1em} ventricular tachycardia
Figure 1. Clinical evaluation of the 16-year-old male arrhythmogenic right ventricular dysplasia/cardiomyopathy patient. A, The patient presented with sudden cardiac arrest while swimming. An automated external defibrillator detected monomorphic ventricular tachycardia, which degenerated into ventricular fibrillation successfully treated by defibrillation. B, Cine cardiac magnetic resonance imaging showed an enlarged right ventricle with dyskinesia in the inferior, acute angle, and anterior walls (arrows) under the tricuspid valve. C, 12-lead ECG revealed T-wave inversion V1–4. D, Hourly premature ventricular complex (PVC) counts on 24-hour Holter monitoring 1 month after presentation (total 24-hour PVC count: 7216). VE indicates ventricular ectopy.
Figure 2. Electroanatomic voltage mapping during first endocardial/epicardial ventricular tachycardia ablation. Voltage mapping revealed scar (<0.5 mV) in the epicardial right ventricular (RV) basal lateral–free wall and anterior RV outflow tract with double and late potentials in the border zone merging into normal myocardium. AP indicates anteroposterior; INF, inferior; LAO, left anterior oblique; LL, left lateral; PA, posteroanterior; RAO, right anterior oblique; RL, right lateral; and SUP, superior.
Figure 3. Provocative autonomic testing before and after sympathectomy. Continuous noninvasive blood pressure (A), heart rate (B), finger pulse volume (C), and skin conductance (D) were recorded at baseline, and during 2 sympathetic stressors (handgrip exercise and mental stress induced by a Trier test) before (solid line) and after (dashed line) bilateral cardiac sympathectomy. Recordings were also made during a final baseline to assess recovery from sympathetic stress. Spectral analysis of heart rate variability (E and F) was also performed on electrocardiographic tracings recorded at baseline before and after sympathectomy. In composite, testing revealed the hemodynamic and neurophysiologic responses to stress after sympathectomy. HF indicates high frequency; and LF, low frequency.

Figure 4. Number of implantable cardioverter–defibrillator (ICD) discharges and median premature ventricular complex (PVC) burden on 24-hour Holter monitoring during 16 months pre-sympathectomy and 12 months post-sympathectomy. Bars indicate ICD discharges; dots indicate PVC count with error bars indicating range. The patient experienced 78 discharges pre-sympathectomy compared to none post-sympathectomy; PVC count decreased from 5697 per 24 hours (range, 3029–8767 per 24 hours; n=4) pre-sympathectomy to 676 per 24 hours (range, 673–679 per 24 hours; n=2) post-sympathectomy.
Role of Bilateral Sympathectomy in the Treatment of Refractory Ventricular Arrhythmias in Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy
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