Unilateral sympathetic ganglion denervation in the management of sustained ventricular tachycardia

Muhammad Amer, MD, MHS, Whitney M. Burrows, MD, Timm M. Dickfeld, MD, PhD, FHRS

From the University of Maryland Medical Center, Baltimore, Maryland.

Introduction

Cardiac sympathetic activity contributes to ventricular electrical instability and makes the heart vulnerable to malignant ventricular tachycardia / ventricular fibrillation (VT/VF), while stellate ganglionectomy can prolong the ventricular refractory period, increase the VF threshold, and decrease VT/VF inducibility. Cardiac sympathetic denervation is an effective adjunct procedure to reduce fatal arrhythmias intolerant to beta blockers. We present a case of ischemic cardiomyopathy with post revascularization drug-refractory VT/VF in which the patient was successfully treated with left cardiac sympathetic denervation (LCSD) followed by local invasive sympathetic ganglion block.

Case report

A 49-year-old obese male ex-smoker presented with worsening dyspnea on exertion and chest tightness. A 12-lead electrocardiogram showed ST-segment elevation in inferior leads with elevated cardiac enzymes (troponin I, 12.11 ng/mL). Left heart catheterization showed complete occlusion of the right coronary artery and proximal left anterior descending artery with left-to-left collaterals, and near-complete occlusion of obtuse marginal artery in a right-dominant system. Two-dimensional echocardiography showed mild concentric left ventricular hypertrophy, wall motion abnormalities of inferobasal segments, and left ventricular ejection fraction of 45%–50%. Coronary bypass grafting (left internal mammary artery to left anterior descending artery, saphenous vein to posterior descending artery) was performed without complications. On postoperative day 1, while on vasopressors and balloon pump, the patient was defibrillated twice (Figure 1) for successive episodes of cardiac arrest owing to VT and VF. Despite aggressive replacement of serum electrolytes and amiodarone infusion, he went into electrical storm, requiring multiple defibrillation shocks, reintubation, and cannulation for extracorporeal membrane oxygenation (ECMO) (cardiogenic shock) later that night. The patient was continuously maintained on high doses of amiodarone, lidocaine, and mexiletine. Overdrive epicardial ventricular pacing was started given slightly prolonged corrected QT (460–475 ms on amiodarone infusion) interval. Repeat left heart catheterization

KEYWORDS

Electrical storm; Ganglionectomy; Left cardiac sympathetic denervation; Sustained ventricular tachycardia; Ventricular tachycardia (Heart Rhythm Case Reports 2017;3:467–469)

Address reprint requests and correspondence: Dr Muhammad Amer, Clinical Cardiac Electrophysiology, University of Maryland Medical Center, 22 South Greene St, N3W100, Baltimore, MD 21201. E-mail address: mamer@medicine.umaryland.edu.

http://dx.doi.org/10.1016/j.hrcr.2017.07.002

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ruled out graft closure; however, a drug-eluting stent was placed for a 70% stenosis in the mid obtuse marginal artery.

While the patient was adequately sedated and on antiarrhythmic therapy, sustained VT/electrical storm recurred whenever the epicardial ventricular pacing rate was reduced from 100-120 beats per minute (Figure 2), without reproducible induction pattern (eg, “long-short” pattern or identical premature ventricular contractions). Attempts to wean vasopressors or ECMO were unsuccessful. Given his hemodynamic instability and comorbidities (acute renal failure needing renal replacement therapy, ongoing retroperitoneal bleed, *Escherichia coli* bacteremia, *Clostridium difficile* colitis, and respiratory decompensation), the patient was deemed too high-risk for a VT ablation. Under ultrasound guidance, repeated left-sided stellate ganglion block (×3) using incremental injection of 5 mL of 0.5% ropivacaine and 3 mL of 2% lidocaine and epinephrine to assess the effect of sympatholytic denervation therapy resulted in reproducible, temporary freedom from VT/VF (Figure 2). A left thoracoscopic sympathectomy with T1 ganglionectomy accompanied by dissection of Kuntz fiber were then performed after holding systemic heparin infusion 2 hours before the procedure while the patient remained on ECMO. The procedure went without complication and no further VT or VF were observed thereafter (Figure 2). A dual-chamber cardioverter-defibrillator was then implanted for secondary prevention. The patient was slowly weaned off vasopressors, decannulated, and extubated, with full neurological recovery and complete removal of antiarrhythmic therapy. No recurrence of VT or VF was observed during a 78-day observation period post ganglionectomy.

**Discussion**

Enhanced cardiac sympathetic activity causes early and delayed afterdepolarization, as well as increases dispersion of repolarization, and contributes to ventricular electrical vulnerability, leading to heightened risk of malignant VT.1–3 Stellate ganglionectomy can prolong the ventricular refractory period and increase the VF threshold and decrease VT/VF inducibility in the setting of myocardial infarction.4 LCSD is an effective adjunct procedure to reduce fatal arrhythmias, especially among patients with long QT syndrome and catecholaminergic polymorphic VT intolerant to beta blockers.5,6 In addition, LCSD has been shown to be an effective therapeutic intervention in patients with drug-refractory VT/electrical storm, with significantly higher

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**KEY TEACHING POINTS**

- Enhanced sympathetic activity contributes to ventricular electrical vulnerability and heightened risk of malignant ventricular tachycardia.
- Cardiac sympathetic denervation is an effective adjunct procedure to reduce fatal drug-refractory ventricular arrhythmias.
- Locally invasive sympathetic ganglion block may identify patients with higher chances of long-term clinical benefits before definitive unilateral or bilateral cardiac sympathetic denervation.

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**Figure 2** Ventricular tachycardia/defibrillation frequency before and after left cardiac sympathetic denervation (LCSD). AAD = antiarrhythmic drugs; CABG = coronary artery bypass graft; LHC = left heart catheterization.
1-year survival rate as compared to conventional Advanced Cardiac Life Support guideline–recommended antiarrhythmic drugs (67% vs 5%; \( P < .0001 \)). Similarly, in patients with structural heart disease and drug-refractory monomorphic or polymorphic VT and failed ablation attempts, a significant decline in arrhythmia burden was shown after unilateral\(^8\) and bilateral cardiac sympathetic denervation, respectively.\(^9\) A local, minimally invasive sympathetic ganglion block with demonstrated freedom from VT/VF may further identify patients with higher chances of long-term clinical benefits before definitive unilateral or bilateral sympathetic ganglion denervation.

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