Bilateral Cardiac Sympathetic Denervation on an ECMO patient for Refractory Ventricular arrhythmia: A Case Report.

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Abstract

Genetic syndromes such as Brugada syndrome can lead to lethal ventricular arrhythmias. Cardiac Sympathetic Denervation has been shown to be effective in ameliorating refractory ventricular arrhythmias. We present a 33-year-old black female with a past medical history of Brugada syndrome with an implantable cardiac defibrillator (ICD), who presented with refractory ventricular tachycardia/atrial fibrillation leading to heart failure and cardiogenic shock, requiring Extracorporeal membrane oxygenation (ECMO). The patient subsequently underwent bilateral stellate ganglion sympathetic denervation in the setting of refractory ventricular arrhythmias. We present this case report to showcase that thoracoscopic bilateral sympathetic denervation can be an effective definitive treatment option for ventricular arrhythmias that remain refractory to medical management.

Introduction:

Sudden cardiac death is thought to be caused by ventricular arrhythmias in 75% to 80% of cases, resulting in 184,000 to 450,000 deaths in the United States per year [1]. Ventricular arrhythmias are most commonly due to myocardial infarction or cardiomyopathy. Genetic Syndromes such as Brugada Syndrome or catecholaminergic-related polymorphic ventricular tachycardia (CRPVT), are common causes of ventricular arrhythmias but these typically occur in younger patients [2]. An electrical storm (ES) is defined as at least three episodes of ventricular arrhythmias including ventricular tachycardia (VT) or ventricular fibrillation (VF) in 24 hours, significantly increasing risk of heart failure and mortality. An ECMO circuit uses a modified cardiopulmonary machine to support patients and allow time for their cardiac and/or pulmonary function to improve. In instances of refractory ES, case studies have shown that ECMO support can be utilized as a bridge to therapy [3].

Multiple treatments for ES have been proposed, including sympathetic blockade with beta-blockers (BB), anti-arrhythmics, and catheter ablation but due to drug resistance and refractory arrhythmias, other methods have been proposed. Stellate ganglion blockade (SGB), and Cardiac Sympathetic Denervation (CSD) have been attempted in instances of medically refractory ES [4]. We present a patient with Brugada Syndrome and refractory ventricular arrhythmia on ECMO who underwent Video-assisted thoracoscopic surgery (VATS) and Bilateral Cardiac Sympathetic Denervation (BCSD)

Case Presentation:

Our patient was a 33-year-old black female with a past medical history of Brugada syndrome, she had a St Jude Implantable cardiac defibrillator (ICD) implanted in 2009. Despite her ICD placement, subsequent Radiofrequency ablation (RF) ablation in 2013 and quinidine therapy she remained with persistent atrial fibrillation. She presented to the Emergency Department (ED) with complaints of midsternal non-exertional chest pain and shortness of breath. Initial EKG demonstrated atrial fibrillation with controlled ventricular rate and inferior lateral T-wave inversions. Troponin levels were negative. The patient subsequently went

into pulseless VT and despite attempted ablation, she remained in VT. She received multiple rounds of CPR with defibrillation until return of spontaneous circulation (ROSC) was achieved. The patient was intubated and placed on ECMO via right femoral access. Cardiothoracic Surgery was consulted to perform a BCSD.

Procedure:

The patient was brought to the operating room to undergo bilateral VATS procedure. After insertion of a camera port and 2 additional working ports in the right chest, the right sided sympathetic trunk and stellate ganglia were identified. The sympathetic trunk along with the inferior portion of the stellate ganglia were mobilized at the level of T1-T4 and were then divided using electrocautery. A lateral extension was done to dissect the nerves of Kuntz. The surgical procedure was then repeated on the left side. Bilateral chest tubes were placed. The patient tolerated the procedure well.

Following the procedure, the patient did not experience any episodes of VT and she subsequently remained in sinus rhythm. A postoperative echo demonstrated improved ejection fraction of 40% and the patient was decannulated from ECMO 3 days after the operation. The patient continued to improve and was weaning off her blood pressure support. She remained in sinus rhythm and on anticoagulation due to right lower extremity DVT. Unfortunately, the patient experienced sudden onset hemorrhagic shock from a spontaneous liver laceration several weeks after the operation and expired.

Discussion:

Brugada Syndrome is an inherited cardiac electrical disorder occurring in the absence of obvious structural heart disease, leading to right bundle branch block, ST elevation and sudden cardiac death due to polymorphic ventricular tachycardia. Patients with Brugada Syndrome can suffer from electrical storms [5]. The stellate ganglion is a collection or group of sympathetic nerve fibers responsible for innervating the arms, face, and chest. During an ES, the excess catecholamine release from sympathetic fibers can lead to sympathetic hyperactivity outflow to the heart resulting in potentially fatal arrhythmias [4] [3].

Studies have shown benefit in restoring systemic circulation using ECMO in patients with cardiogenic shock related to ES and hemodynamic instability in ventricular arrhythmias [3]. ECMO support can stabilize the patient in order to facilitate future surgical interventions in more favorable hemodynamic conditions. Despite documented benefits, there appears to be an increase in mortality that is directly proportional to length of time on ECMO [6]. This supports the use of ECMO as a bridge to intervention rather than for prolonged survival in patients with cardiogenic shock.

Stellate Ganglion Block is traditionally performed by injecting local anesthetics percutaneously to the stellate ganglion. Though SGB has been shown to be effective, its therapeutic effectiveness and duration is variable depending on the type of anesthesia and method of administration [7]. This variability is related to the pharmacodynamics of the agents used, site of injection, and thickness of the ganglion sheath.

CSD describes the surgical resection of the majority or the lower half of the stellate ganglion as well as the sympathetic chains from T1-T4. CSD interrupts the major source of norepinephrine released to the heart and has multiple antiarrhythmic effects including increasing the threshold for ventricular fibrillation and increasing ventricular refractory period [8]. When standard medical treatments fail, Wilde et al. demonstrated the effectiveness of left sided CSD in patients who suffered from catecholaminergic polymorphic VT [8]. Symptoms were controlled for up to 20 years postoperatively in some patients, although ventricular arrhythmias did occur at high workloads. Left Cardiac Sympathetic Denervation (LCSD) is more commonly performed, but Bilateral Cardiac Sympathetic Denervation (BCSD) or right sided CSD (RCSD) performed as an adjunct to a previously failed LCSD has also been performed with promising results [9] [10]. In canine studies comparing left, right, or bilateral sympathectomy, the most profound anti-arrhythmic effects were seen with bilateral sympathectomy [11]. Despite being more invasive, bilateral CSD appears to provide a more definitive and effective therapeutic intervention. It can prevent catecholamine surges and decrease the likelihood of potentially life-threatening arrhythmias that are refractory to defibrillation.

Conclusion :

We present this case in order to review a rare condition and suggest that in cases when routine management of ES, such as defibrillation, anti-arrhythmic therapies, and ablation, fail to control life-threatening ventricular arrhythmias, ECMO support followed by CSD can be an effective and definitive treatment option. All of these patients should undergo surgical intervention with an experienced cardiothoracic surgeon.

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