Role of Stellate Ganglion Block in Refractory Ventricular Arrhythmias- A Case Series

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Abstract

Refractory ventricular tachycardia is a life-threatening condition. Therapeutic modalities for patients with ventricular tachyarrhythmias include atrioventricular nodal (AV) nodal blockade agents, anti-arrhythmics and radiofrequency catheter ablation. Sudden cardiac death associated with ventricular arrhythmias can be prevented with an implantable cardioverter-defibrillator (ICD) but the management of ventricular storm unresponsive to medical therapy remains a significant clinical challenge. A novel therapeutic approach involving sympathectomy via ultrasound (US) guided left sided stellate ganglion block and report associated outcomes.

Introduction

Sympathectomy has been used for centuries and has various applications in pain management, psychiatry and more recently cardiology [1]. Physicians have performed sympathectomy via cervical stellate ganglion blockade for pain relief from abdominal tumors, complex regional pain syndrome, intractable angina, phantom limb pain, postherpetic neuralgia and hot flashes [2,3]. Although left sided stellate ganglion block (SGB) for ventricular tachyarrhythmias is a novel approach with variable reported success rates, the high mortality associated with refractory ventricular arrhythmias is rarely reported in literature for this clinical indication. We report a series of 5 patients with refractory ventricular arrhythmia and their treatment with left sided ultrasound guided SGB.

Case Presentation

Case 1

A 60-year-old male patient presented with a past medical history of congestive heart failure (Ejection Fraction 15-20%), mechanical Aortic and Mitral valves and Diabetes Mellitus. He had a recent admission for implantable cardioverter-defibrillator (ICD) discharge with sustained ventricular tachycardia (VT) (HR 130-140s). During that admission, he was not considered a candidate for radiofrequency catheter ablation due to the presence of mechanical valves and was discharged on amiodarone, mexiletine and metoprolol. He presented again to the hospital after multiple episodes of ICD discharge, dizziness, and palpitations over a 5-day period. He was found to have multiple episodes of non-sustained ventricular tachycardia (VT) lasting 1-3 seconds and 4 episodes of sustained VT (HR 130-140’s) treated with anti-tachycardia pacing (ATP). 3 out of the 4 ATP therapies did not terminate VT. Cardiology consulted pain management for further options and a left sided ultrasound guided SGB was performed in the intensive care unit. The patient did not have recurrence of VT in the hospital and was discharged. The arrhythmia log from his ICD was monitored subsequently for the next 6 weeks and was noted to be without any new episodes of VT.

Case 2

A 55-year-old male patient presented with a past medical history of non-ischemic cardiomyopathy (NICMP) secondary to alcohol abuse diagnosed 12 years prior, with an EF of 10% requiring an ICD placement with subsequent upgrade to implantable cardiac resynchronization therapy with defibrillator (CRT-D) a year prior to his current presentation. He also had a history of multiple comorbidities including chronic kidney disease in stage 3, hypertension (HTN), obstructive sleep apnea and cerebrovascular accident with residual weakness. He recently was started on Amiodarone as an antiarrhythmic medication for newly diagnosed atrial fibrillation. Revascularization at that time was attempted, with a drug eluting stent placed in the obtuse marginal artery, with unsuccessful angioplasty of the right coronary artery. He presented to the hospital this time after recent admission for implantable cardioverter-defibrillator (ICD) shock while at home. An extensive history of recurrent VT resulting in ICD shocks was reported. The patient initially went for endocardial VT ablation in an area of inferio-septal scarring. Recurrent episodes of VT occurred despite increased...
A 27-year-old female presented to our hospital after syncope and multiple ICD shocks which persisted despite antiarrhythmic therapy. She had a past medical history of idiopathic cardiomyopathy requiring secondary prevention of cardiac arrest from ventricular fibrillation/ventricular tachycardia VT/VF with an ICD, which was then upgraded to dual chamber ICD. On examination, she was found to have multiple premature ventricular contractions (PVC) despite having extensive ablation of the right and left ventricular outflow tract in the past. The pain management team was consulted for management of refractory VT. She underwent a left sided ultrasound guided SGB in CICU and remained free of VT for 72 hours with subsequent return of polymorphic VT. On day 5 post SGB she was taken to the operating room and had video assisted thoracotomy with thoracic cardiac sympathectomy (dissection of stellate ganglion) which also failed to decrease her VT burden. She was treated with lidocaine drip, sotalol and metoprolol tartrate, underwent another PVC ablation and was eventually started on high dose Mexiletine (200mg q8h). Despite treatment with multiple anti-arrhythmic and PVC ablation, she continued to have runs of polymorphic VT’s and subsequently left the hospital against medical advice while awaiting heart transplantation.

## Case 5

A 54-year-old male with a past medical history of HTN, CAD s/p multiple prior percutaneous coronary interventions to left anterior descending artery (LAD), with known extensive inferior myocardial wall scar (by voltage mapping), ischemic cardiomyopathy (EF 10-15%), prior pulmonary embolism a year ago, and recurrent VT s/p ICD placement (1 year ago) was admitted after presenting with 9 ICD shocks for VT. He also had a history of Pulseless electrical activity (PEA) arrest s/p shock at another hospital prior to presentation. Endocardial VT ablations were tried twice targeting inferior myocardial wall scar, but he continued to have recurrent VT. During the last ablation procedure, he was noted to have up to 8 VT morphologies. When seen by the pain management team, the patient was intubated, sedated, and was on amiodarone and lidocaine drips in the ICU. He underwent successful left sided ultrasound guided SGB. After 12 hours the patient went into pulseless VT requiring 2 shocks from his AICD and then returned to sinus rhythm. Patient was extubated 2 days later but continued to have VT. Patient had Heartmate 3 left ventricular assist device (LVAD) placement done 3 days post sympathectomy procedure. He also had extensive epicardial and endocardial cryoablation of the inferior wall from the base to the apex as well as of the infarcted wall at the time of LVAD implantation. He continued to have recurrence of VT requiring ICD therapies and was eventually placed on heart transplant list. His heart failure status was optimized, and he was discharged home after 2 weeks.

Ultrasound Guided SGB Procedure performed in all 5 patients: To perform a successful block, good understanding of the anatomy is paramount since the ganglion is surrounded by multiple structures increasing the likelihood of iatrogenic complications. In the majority of people, the stellate or cervicothoracic ganglion is made from the inferior cervical and the first thoracic ganglia. The approach to the ganglion is surrounded by the vertebral column and the brachial plexus.
Dutta et al reported common complications associated with SGB and noted hoarseness/dysphagia to occur in almost 54% of the patients [6]. Other less common complications include pneumothorax and contralateral Horner's syndrome. The most dreaded complication, although rare, remains retropharyngeal hematoma which may require urgent intubation for airway protection [7]. To decrease the likelihood of complications, imaging is used via ultrasound or fluoroscopy and injection of local anesthetic can be made near the C6 tubercle (Chassaignac’s tubercle). This allows for anesthetic spread to the ganglion and decreases the chances of accidental vertebral artery injury at C7. In our case study, standard American society of Anesthesiology (ASA) monitors and sterile precautions were used. Ultrasound and color doppler were used for visualization of anatomic structures, including the transverse process and anterior tubercle of C6, longus coli muscle, prevertebral fascia, and carotid artery. Following a lateral in plane approach, a 4-inch 22G Stimuplex-Ultra 360 needle was directed to the prevertebral fascia between the carotid artery and the tip of C6 anterior tubercle. A total of 8 ml of Bupivacaine 0.25% with 2 ml of Lidocaine 2% (w/Epi) and 4 mg of dexamethasone was injected in the prevertebral fascia plane just above longus coli muscle [Figure 2].
Figure 2: Stellate Ganglion Ultrasound Anatomy
CA- Carotid Artery, VB- Vertebral Body, SG- Stellate Ganglion, IJV- Internal Jugular Vein, ASM- Anterior Scalene Muscle, SCM- Sternocleidomastoid Muscle, M- Medial, L- Lateral, N- Needle, Asterisk symbol (*)- marks the final needle position

All 5 patients tolerated the procedure well and Horner Syndrome was noted after the procedure.

Discussion

Treatment of ventricular tachyarrhythmias primarily depends on hemodynamic stability of the patient. General approach for stable tachyarrhythmias includes pharmacotherapy and if needed radiofrequency catheter ablation (RFCA) while hemodynamically unstable patients are usually treated with cardioversion/defibrillation in conjunction with medical therapy. Treatment of refractory cases remains challenging especially when all pharmacotherapies have been exhausted and patient has either failed RFCA or is too unstable for the procedure [8,9,10]. Left sided SGB blocks offers a relatively safe, bedside, ultrasound guided alternative in these patients by inhibiting the cardiac accelerator fibers (T1-T4) that underlie the sympathovagal imbalance implicated in these refractory cases [11]. In animal models, sympathectomy resulted in the inhibition of maladaptive remodeling of the autonomic nervous system and spinal cord pathways which were responsible for arrhythmia post MI [12]. In our case series, 3 patients out of 5 patients had significant reduction in the ventricular tachycardia burden which is in concordance with the study by Fadim et. al who reported a 50% success rate for the same endpoint [13]. Till date, the number of patients on which SGB has been performed for treatment of refractory ventricular arrhythmias has been rare. In fact, a recently published meta-analysis was able to find only 35 patients in a span of 57 years from multiple individual case reports. They also concluded that SGB can cause acute reduction in the ventricular arrhythmia burden [13]. Our experience helps provide additional evidence to support the use of SGB as an alternative therapy for patients with refractory ventricular arrhythmias especially where other options have been exhausted. It may also be helpful to buy additional arrhythmia-free time for the sickest of patients and bridge them to heart transplant when that option is available.

Conclusion

Authors conclude that US guided bedside cervical stellate ganglion block offers a low-risk alternative with reasonable success rate in patients with refractory ventricular arrhythmias who would otherwise have close to 100% mortality. Additionally, SGB has the potential to bridge towards a definitive therapy such as heart transplantation. Considering the scarcity of available literature about the safety, utility and efficacy of this under-utilized procedure, this series provides additional useful evidence regarding the utilization of SGB in refractory ventricular arrhythmias.

References

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